the OIL AND GAS JOURNAL
PUBLISHED WEEKLY JUNE 5, 1961

Push begins for more gas regulation ▸ 36

What Russia will show U. S. gas men ▸ 40

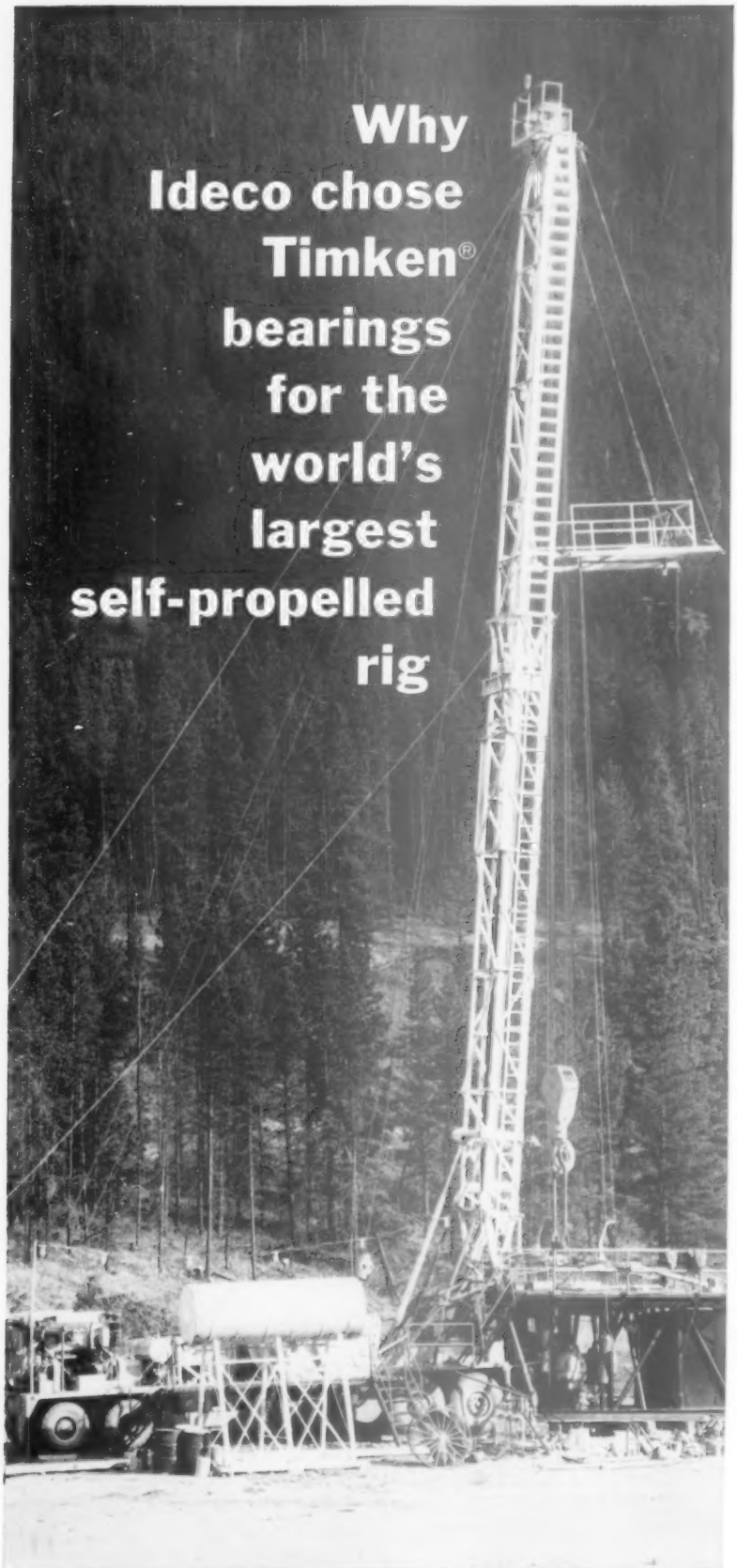
How to engineer a fire flood ▸ 58

Sulfur plants in economy packages ▸ 80

Big 7 may become Big 10 in the fight for

THE WEST COAST GASOLINE MARKET

p. 33



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tapered roller bearings

OIL AND GAS JOURNAL
Vol. 59, No. 23

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TECHNOLOGY—OPERATION

Drilling-Production

How to Engineer an In Situ Combustion Project 58
By T. W. Nelson and J. S. McNeil
Here's an article that goes a step beyond the theory, experimentation, and field results that have been published before. This one outlines a procedure for the petroleum engineer to follow as a guide in setting up a full-scale thermal-recovery project.

Drilling's No Problem in Tierra Del Fuego 66
By Ed McGhee
However, transportation problems are a headache in this southernmost windswept oil province where substantial and increasing production has important consequences. The island's new wells are helping the Argentine Republic toward self-sufficiency in oil.

New Chrome-Lignite Drilling Mud is Cost-Cutter 86
By Billy Paris
First field trial of this new mud additive has been a marked success and raises hopes for lower mud costs for the Gulf Coast. Chemical costs are kept to an average of $1.16 per ft., usually a low cost for a 15,000-ft. well.

Oil-Well Pumping—43 92
By Joseph Zaba
Slim-hole rod pumping.

Refining-Processing

DX Sunray Tests Foam Depressants in Delayed Cokers 65

Questions on Technology 70
Breakeven cost of operating tankers.

How to Predict Contaminant Coke Yield 71
By H. R. Grane, J. E. Connor, and G. P. Masologites
Its formation depends on (1) feed properties, (2) catalyst residence time in reaction zone, (3) catalyst surface area, (4) metal concentration, and (5) number of cycles of regeneration metals have undergone.

The Foreman's Page 79
Here's a quiz on heat transfer, Part 7 in the current series.

Package Sulfur Plants are Economical 80
By H. Grekel, L. V. Kunkel, and R. Mungen
Eight package sulfur plants have been built by Pan American Petroleum Corp. and its licensees. Operating experience shows a very low operating and maintenance cost.

Processing Notes 82
Aromatics pace petrochemicals at Suntide—new computer service bureau—new oxo alcohol unit—Opcon controls styrene production. A new feature tailored to the needs of the processing man.

Refinery Cost Indexes 94

Pipelining

Pipeline River Crossing Uses Well Points 96
By J. P. O'Donnell
Economy and convenience were two factors that determined the choice of a well-point system for a multiple pipeline crossing of the Arkansas River. Underwater work was avoided.

THE OIL AND GAS JOURNAL **Newsletter**

June 5, 1961

Watch for decision on which agency will take over oil-planning role for the White House, now that OCDM is being reorganized.

OCDM originally certified need for oil import controls. It currently is studying aspects of residual fuel and asphaltic crude programs, and it reports periodically on resid prices.

OCDM—which will become Office of Emergency Planning—would like to retain such oil jurisdiction, but others also are interested. Showdown will come after the President returns from abroad.

There will be no basic change in oil import-control program for last half of this year. Interior Secretary Stewart Udall says this does not rule out possible changes later, perhaps for first half of 1962. Meanwhile, look for last-half allocation to be made about mid-June.

The National Association of Railroad and Utilities Commissioners is trying to make a **case for tougher natural-gas regulations** before the Senate.

It has a bill in the mill which would outlaw certain types of indefinite-pricing clauses in natural-gas contracts, give FPC jurisdiction over sales of gas for resale for industrial use, and prevent successive rate increases when the initial rate hike still is pending. The bill also would require FPC to make a specific finding of "pubilc interest" in rates proposed in certificate cases and require FPC examiners and commissioners to act within a specified time after a case is opened (p. 36).

▼ ▼ ▼

A **deep drilling campaign** for objectives well below present shallow producing horizons appears in the offing for the Appalachian area.

Shell is reported to be the biggest leaseholder among the majors whose holdings aggregate several million acres. With annual rentals of about $1 per acre, operators are under pressure to evaluate their acreage, and exploration is in progress.

Long-term hopes for maintaining production in the Penn Grade area are being pinned on tertiary recovery. **Two approaches are being watched** closely:

. . . **Injection** of a 27,000-bbl. slug of isopropyl alcohol in a portion of Bradford field is to be completed in September, then water injection will be resumed. South Penn Oil is operator.

. . . A **thermal recovery** project will be fired in August in the Goodwill Hill-Grand Valley field in Warren County, Pennsylvania. Quaker State Oil Refining is conducting the experiment with 46°-gravity crude, highest on which fire flooding has been attempted.

Success with either project would open up possibilities for application to vast reserves

not now economically recoverable in these old producing areas.

Status of **exploration in Canada** is getting increased attention.

Manager of Imperial's western producing region, W. D. C. Mackenzie, says the national oil policy reveals that Canada does not have enough reserves to back up its targets in the years to come. A production target of 800,000 bbl. daily by 1963 is one of the goals of the new policy.

But Mackenzie comments too many wells have been drilled in known fields and not enough exploratory wells are searching for new fields. The overdevelopment of too little oil reserves has contributed to marketing difficulties currently facing the industry.

Another view of the same problem: Canada may be exporting 1.6 million barrels per day of crude into the United States by 1980 to help this country supply an oil demand of 17.5 million barrels daily. The finding rate in Canada may have to be doubled to reach that goal, says A. F. Down, president of BP of Canada.

U. S. and Canada may have an international oil field.

Good shows on tests have been reported at a wildcat in Renville County, North Dakota, just a few feet south of the international line. Successful completion would extend Saskatchewan's South Carievale field across the border (p. 42).

▼ ▼ ▼

Several trends gleaned from gas transmission gathering in Denver:

Natural gas some day may be **sold by the weight** rather than by volume. Big barrier is high cost of today's mass flow meters. Since 1,000 cu. ft. of gas weighs about 45 lb., the cost per pound would be lower than competitive fuels.

Standard pressure base of 14.73 psia. at 60° F. may soon be adopted by the gas industry. AGA approval is expected soon and then a campaign will be started to win approval of state regulatory agencies. It will ease problems for interstate companies.

Several gas companies are using a **plastic instead of concrete as a grout** in compressor stations. They find it less susceptible to distortion but its big advantage is resistance to oil.

A neat trick is saving a Kentucky compressor station its entire cost of electrical power. Gas taken from the main line to meet local fuel needs is dropped in pressure from around 800 to 75 psi. The pressure drop is used to run an engine which drives a generator to provide all the power needs of the station.

▼ ▼ ▼

Wider spacing has received a set back in Mississippi.

The state oil and gas board declined to approve 640-acre spacing for Lower Cretaceous gas development in Sandy Hook field, Marion County. Considerable opposition to this wide spacing came from landowners and royalty holders in the area.

Mississippi to date only has 640-acre spacing for gas wells in the lower Cretaceous section of Gwinville field in Jefferson Davis County.

Keep an eye on Gulf as one of the comers in the West Coast offshore play.

Gulf is one of two companies filing a permit to do preliminary exploration work in

Oregon's tidelands and has shown a renewed interest in California's tidelands by getting a permit to core in Parcel 4 off Santa Barbara County. Gulf bid for acreage off California in 1958, but has not submitted any bids in the 1961 round of leasing.

Prospects are bleak that gas producers in West Central Texas will win a major new gas outlet through their unique reserves pooling campaign.

Major lines which have studied the possibility of extending their systems into the area have found the reserves moderate in size and widely scattered.

Producers are exploring the potential of a plan for connecting existing gas-plant gathering systems as a base for a larger system to gather and deliver gas to a central point. But odds for success here too are not good.

▼ ▼ ▼

Median salary of engineers is now $10,660, up from $10,000 in 1958, latest survey made by National Society of Professional Engineers shows.

Nine out of 10 NSPE members contacted earn more than $7,140; three-fourths earn more than $8,580; and one out of four have annual incomes exceeding $13,750. All these represent increases over 1958. The upper decile, $19,680, is unchanged.

Quickie course on computers is being given by one major oil company to its engineers

Reason: Not to make them computer operators, but to familiarize them with what the machines can do. Then they can request appraisals, reports, and solutions to their problems—and tailor their own material for checking by computers.

▼ ▼ ▼

This may be the year octanes hold steady unless refiners get a demand from marketing managements for a boost in a hurry.

Octanes were steady in May—99.3 for premium and 92.6 for regular, both unchanged from April. For many years, spring was the traditional time for an octane move to kick off promotion for the motoring season. So far this year, nothing has happened. Marketers apparently are resisting any pressure to continue last year's increase in the octane of regular gasolines (p. 42).

Industry notes: **Atlantic Refining** will use a miscible drive this summer as a tertiary-recovery project in a watered-out Yates sand reservoir in South Ward field of Ward County, West Texas. Engineers expect to recover two-thirds of oil remaining (p. 51) . . . **World's deepest fracturing job** has been completed in a West Texas well when treatments were made through perforations from 16,030-16,210 ft. (p. 41) . . . **Lower mud costs** may be possible on the Texas and Louisiana coasts, first field tests of a new experimental chemical mud additive indicate. The additive is a chrome-lignite complex which keeps the mud in excellent condition throughout drilling and completion in the deep tests where high temperatures are encountered (p. 86) . . . **Jersey Standard** is merging its two big domestic pipelines—Interstate and Humble—into a single company (p. 50) . . . **BP Canada, Ltd.,** has automated its credit-card system by installing the new optical-code scanning system for converting point-of-purchase bills into automated data processing input.

Market memo

June 5, 1961

Chalk up **an opening victory for oil fuel** in its battle to gain wider acceptance for oil-heating equipment in the home market.

The National Fire Protection Association and Underwriters Laboratories have approved in principal **a new low-cost vent** to be used with forced or induced draft oil-fired heaters. The L-vent is a double walled tube about 4-in. diameter with a high quality inner lining. A variety of individual equipment will now be tested and a written standard drawn up.

The break-through means that the standard masonry chimney will no longer be necessary with this type of oil equipment as far as underwriters are concerned. This will cut the installation costs of oil-burning equipment and make fuel-oil men more competitive.

The victory came hard—it took 2 years of work by industry technical experts spearheaded by members of the National Oil Fuel Institute. But it could be a good omen of what may come from the industry's current campaign to expand its markets.

That **1-cent price spread on regular gasoline** between independent and majors in the Los Angeles area has caught the attention of marketers throughout the country.

Tipoff whether the spread becomes statewide is **what happens in San Francisco.** So far a pattern has not emerged there. The major marketers, however, appear firmly committed to a 1-cent differential instead of the historical 2 cents. If the new pricing plan succeeds in California, you can expect it to spread into other states.

The **independent marketers in California face some tough problems.** The 1-cent spread takes away part of their price advantage. But they also are having trouble financing the fancy multipump stations needed to stay in business these days, and the majors dominate both the crude supply and refining capacity on the coast (p. 33).

Sun Oil has **no immediate plans to extend its nine-grade blending** from a single gasoline pump outside the Charlotte, N. C., area.

Vice President Willard Wright says **more time is needed to evaluate** the Charlotte move aimed primarily at offering blends to compete in grade and price with private branders.

The price war which spread from Charlotte over the Carolinas after Sun's introduction of the nine grades has diminished. **Now Charlotte is the only remaining trouble spot.** It has moved uncertainly back toward normal, but the battle appears far from settled.

Esso, the leading marketer, in two moves has restored cuts totaling 9.3 cents on the dealer tankwagon price, returning the level to 15.9 cents a gallon. Esso's retail price is back to a normal 31.9 cents for regular. But **several majors** are 4 cents below Esso and **private brands** are 6 cents under. **Sun's** regular equivalent is 2 cents below Esso.

Price weakness persists in spots in New York, Chicago, Detroit, and St. Louis. But trade sources in the Mid-Continent report there's **a stronger tone to the spot gasoline market,** and the beginning of the motoring season could bring enough demand to send prices back up again. No refiners had raised late in the week, however.

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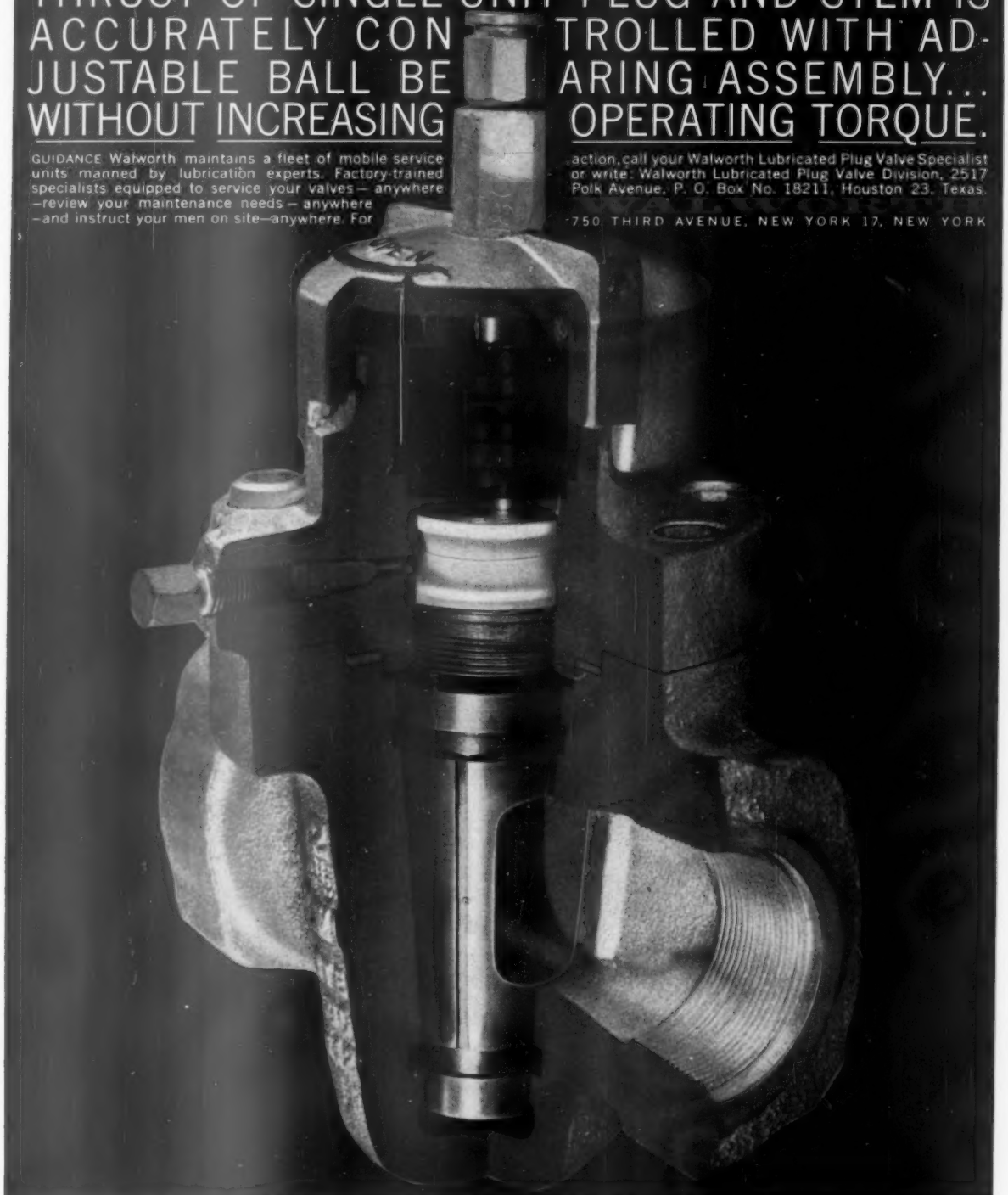

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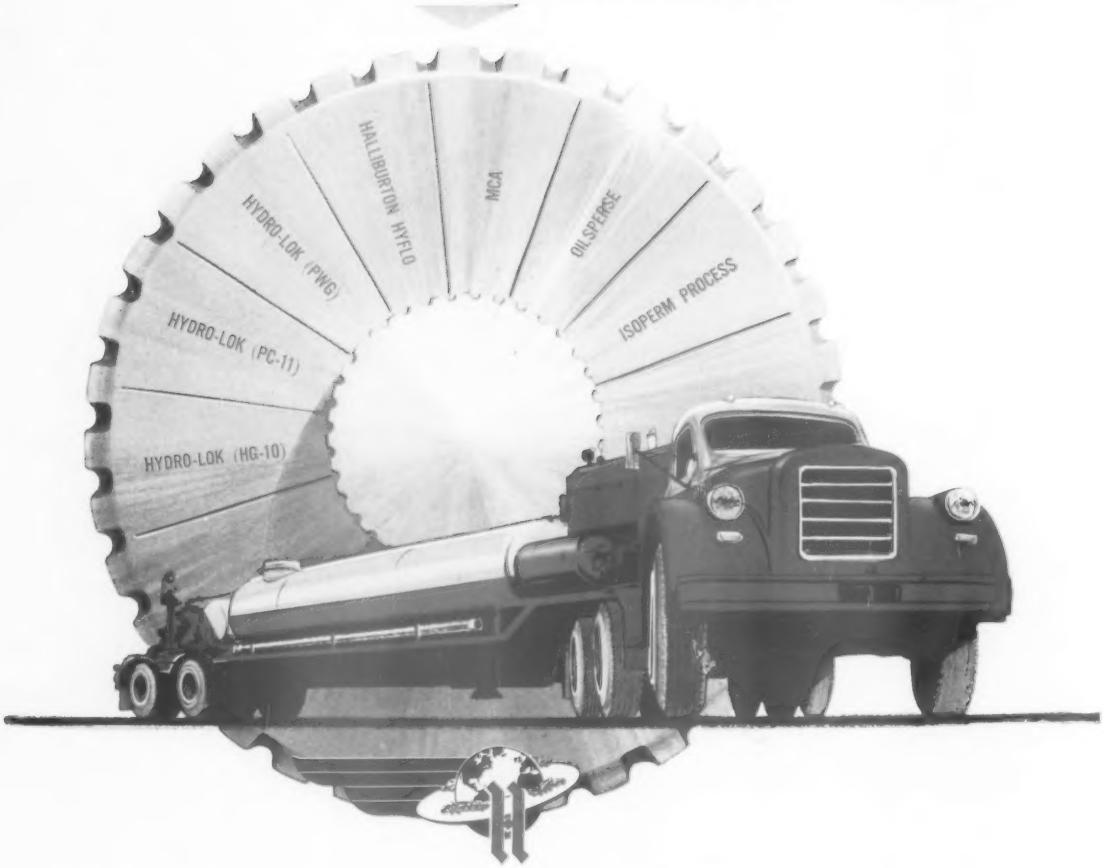

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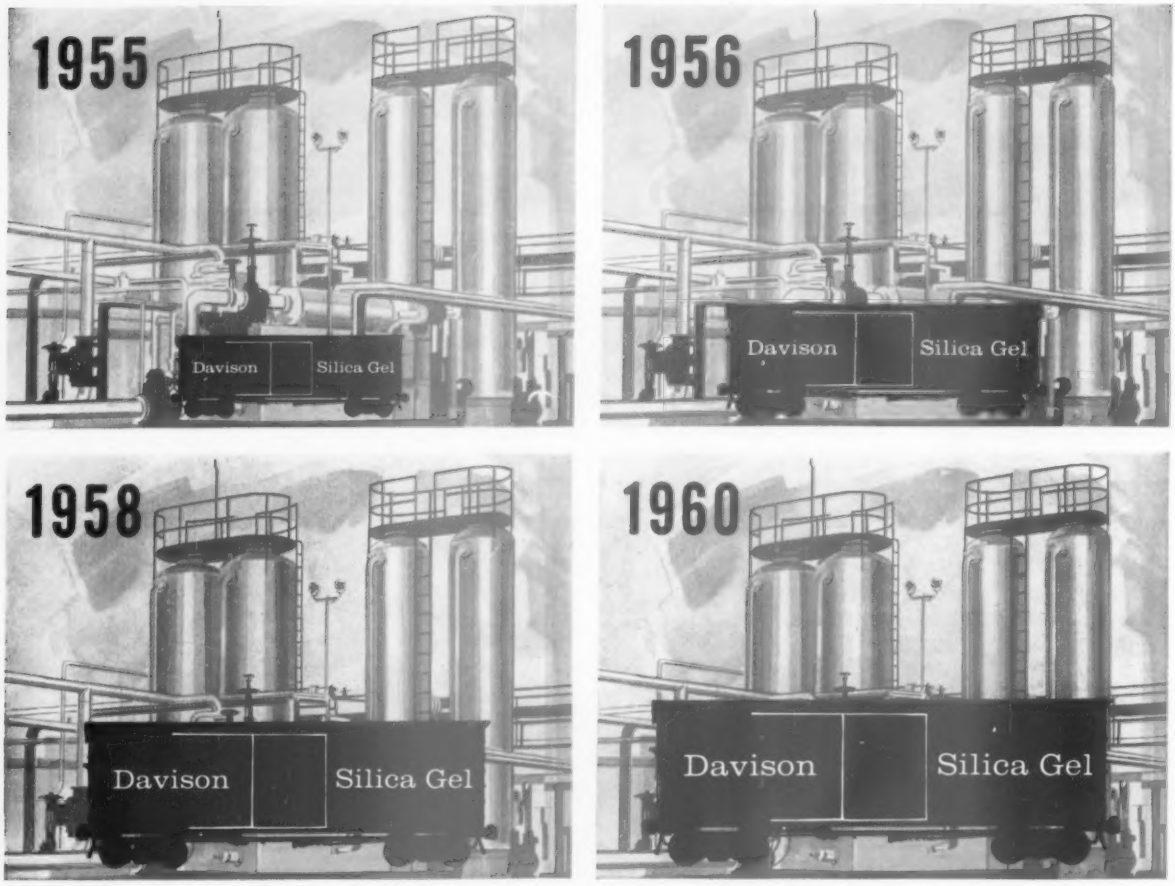

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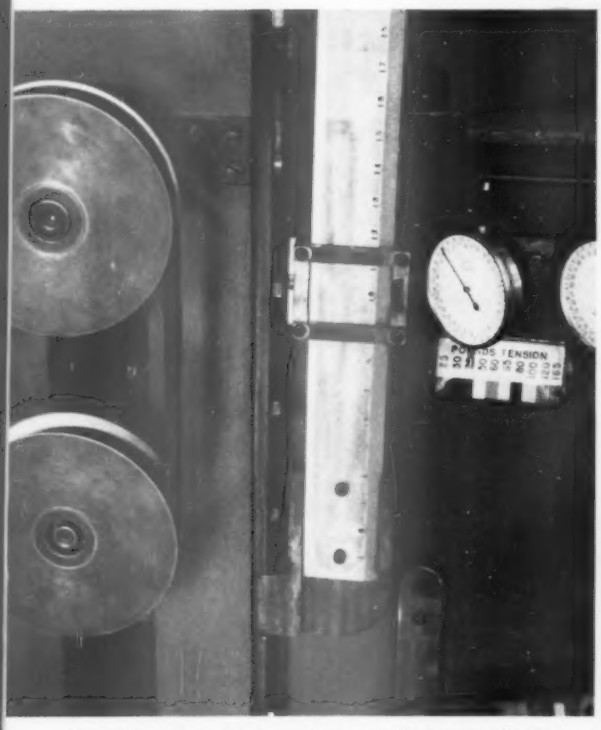
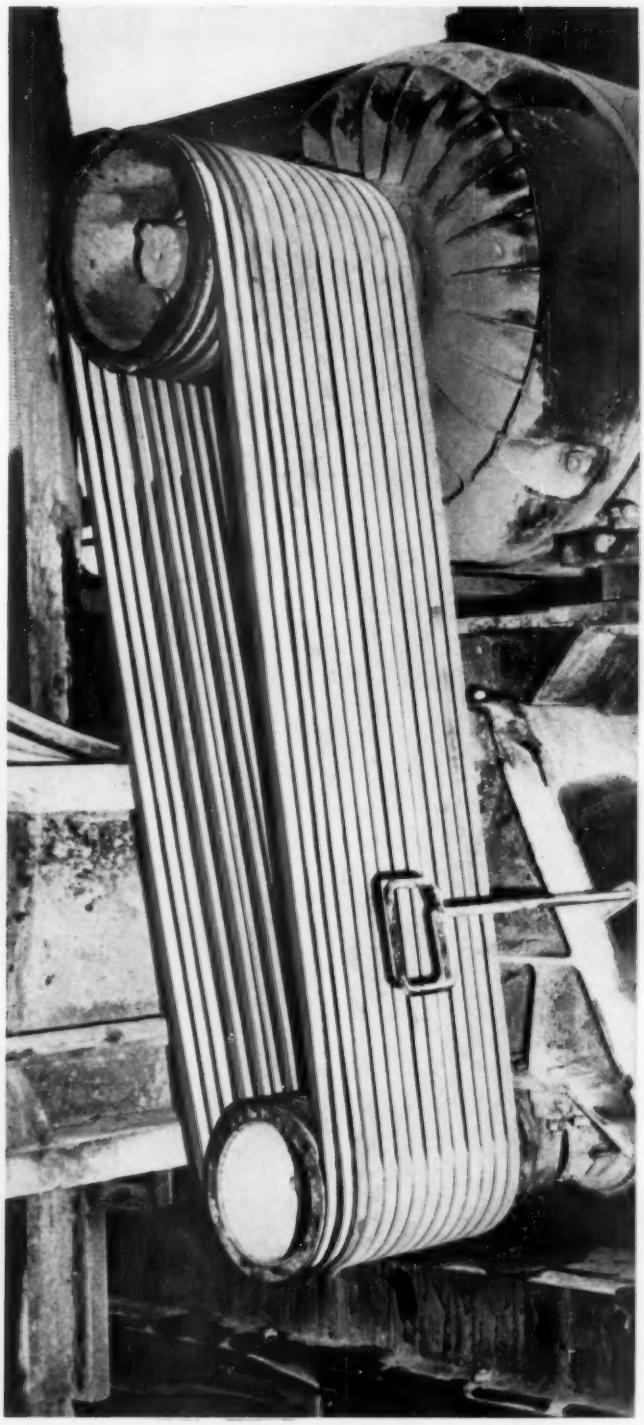
INDUSTRIAL PRODUCTS

CODES TO 1/32"...



Length-coding GREEN SEAL V-Belts to 1/32"—not just 1/10" like most belts—takes this ultra-precision machine. *Only* Goodyear has this type of equipment, which is set by means of fine-tolerance steel templates to insure accuracy.



Harnessing this big, 22-saw stonecutter for 3 full years required COMPASS-V-Steel Belts by Goodyear. Over this period, the Goodyear belts helped carve up 20 tons of rock a day—over 15,000 tons in all. Normal V-belt life in this type of rugged service is a scant 6 months.

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to premium high octane gasoline
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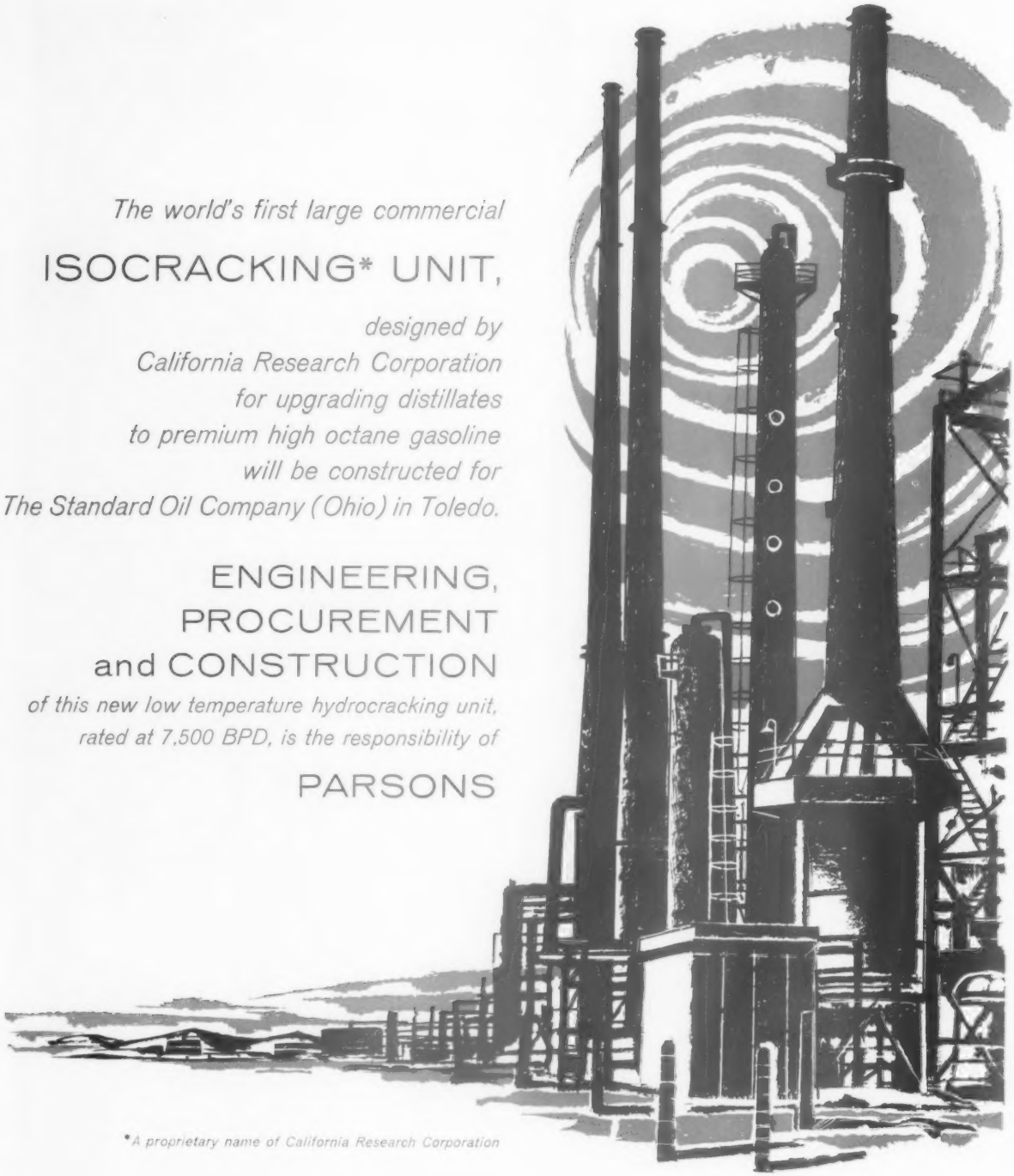

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WORLD WIDE SERVICES: APPRAISALS AND ECONOMIC STUDIES • ARCHITECT-ENGINEERING • CONSTRUCTION • ELECTRONIC SYSTEMS AND COMPONENTS • MINING AND METALLURGICAL ENGINEERING • PERSONNEL TRAINING • PETROLEUM-CHEMICAL ENGINEERING • PETROLEUM PRODUCTION SYSTEMS • PLANT OPERATION • POWER PLANT ENGINEERING

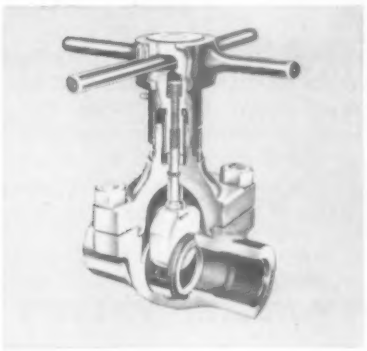
"It's a good feeling to know we have Edward Mudwonder Valves on our #10 rig"

Johnny Sharon, Drilling Superintendent for the Power Rig Drilling Company of Lafayette, Louisiana, has had a lot of experience with Edward Mudwonder valves. Recently we talked to Johnny at Land Rig #10.

"As far as we know," Johnny said, "our #10 rig is the most powerful rig in Louisiana, and it's as versatile as a rig can be. We can drill competitively at anything from 12,000 to 25,000 feet because the rig is designed for versatility, and the equipment on it is selected for rugged, dependable duty. Mudwonder valves give us just that kind of service.

"We have replacement gates and seat inserts on hand, but it's a good feeling to know that we probably won't have to use them. My experience with Mudwonder valves on this new rig bears out the experience I've had on other rigs. That's why #10 is an all-Mudwonder rig, from mud tanks through stand pipe."

This confidence in Edward Mudwonder valves is found wherever you go in the drilling fields. Mudwonder valves are built in 2″, 3″ and 4″ sizes, with screwed or flanged ends, for 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test) service and in 2″ size for 5000 psi WP (10,000 psi test) service. See your favorite oil field supply store, or write Edward Valves, Inc., East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. 6018



EDWARD STEEL VALVES
another fine product by
ROCKWELL

seal

CONSOLIDATED SAFETY RELIEF VALVE'S Sealing Bellows protects against damage from contaminants, corrosion, or viscous fluids

saves

Consolidated Safety Relief Valves are available in both Balanced Bellows and Standard designs. The Standard type has an eductor tube that effectively removes bonnet pressure.

Balanced Bellows Type Consolidated Safety Relief Valves have a durable, two-ply stainless steel Sealing Bellows that isolates and protects working parts from destructive elements in the lading fluid.

The bellows is balanced with the seating surface. Even with superimposed back pressure in the relieving system, valve performance is consistently stable and dependable. The bellows does not affect the high capacity of the valve, nor does it require change in set pressure. Even the blowdown adjustments are limited.

Additionally, Consolidated Safety Relief Valves now offer a no-leak tightness maintained by a resilient "O" Ring Seat Seal retained in the valve disc. This Seal assures tightness at operating pressures far closer to set pressure than with metal-to-metal seats alone, yet does not carry the seat load imposed by the spring. The Seal also takes piping strains much better than all-metal seating.

The Sealing Bellows and "O" Ring Seat Seal are typical of the extra quality built into Consolidated Safety Relief Valves to assure absolute protection for personnel and plant. These fine features plus flat seating and single ring construction also eliminate many maintenance problems and costs. Write for Catalog 1900 and Bulletin 1940.

MAXWELL MANNING M&M & MOORE INC. TRADE MARK

CONSOLIDATED SAFETY RELIEF VALVES

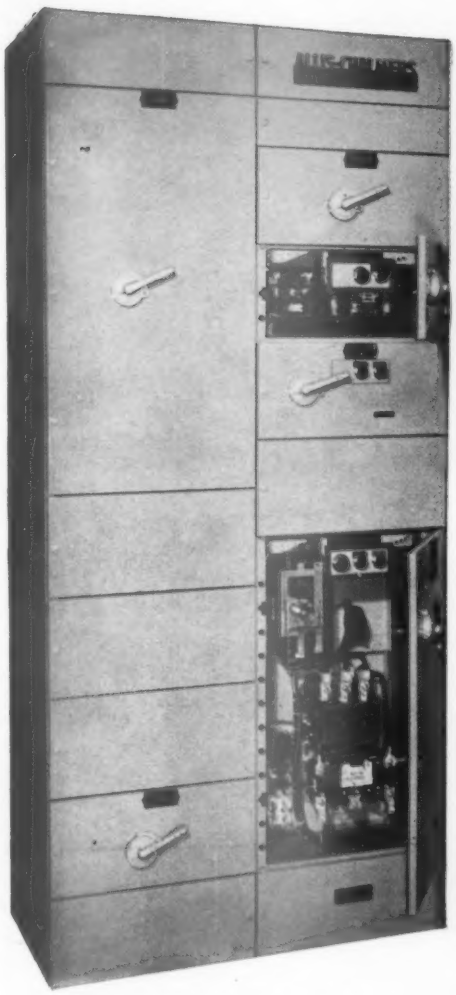
A product of

MANNING, MAXWELL & MOORE, INC.

Valve Division • Tulsa, Oklahoma

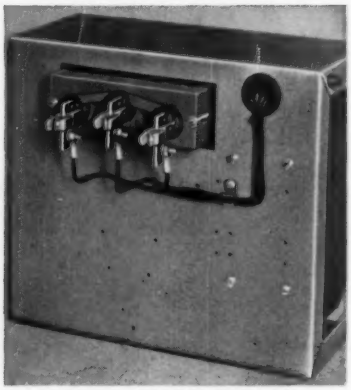
Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
Latin America: Export Division, Chrysler Building, New York, N. Y.
Europe: Manning, Maxwell & Moore, S. A., Fribourg, Switzerland

ALLIS-CHALMERS

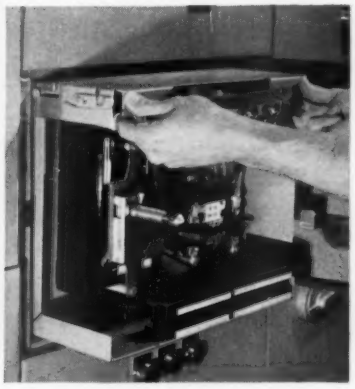


1. Centralized control saves space, cuts installation and engineering costs.

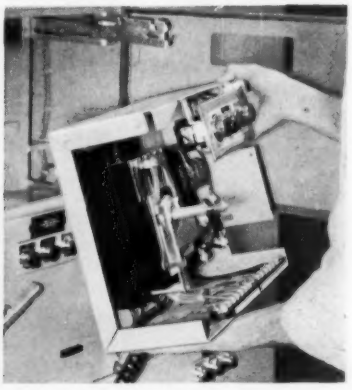
2. Exclusive plug-in terminal blocks permit removal of units without tools. Fully accessible location at front of units simplifies your wiring.



3. Extra heavy plug-in stabs and positive alignment provided by TRACK-GUIDE drawout mechanism assure trouble-free electrical connection.



4. With TRACK-GUIDE mechanism, units can be easily and safely de-energized and locked out, or withdrawn from enclosure for inspection and maintenance.



5. Units can be tilted up for inspection of stabs without removing from TRACK-GUIDE mechanism, or fully removed for bench maintenance or interchange.

...six reasons why Allis-Chalmers new motor control center design is

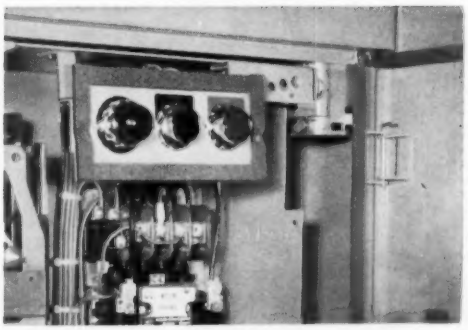
the center of satisfaction

Satisfaction? It comes with every one of the new (yet fully proven) low-voltage control centers from A-C. Their clean lean design saves valuable space. Exclusive plug-in terminal blocks cut installation time . . . speed inspection and removal. *Track-Guide* drawout mechanism lowers maintenance costs. Control units can be drawn out, tilted up, or completely removed without tools.

Safety features of these new control centers provide *sure* protection to personnel. Units can be quickly de-energized for maintenance or inspection work. Units cannot accidentally fall out of *Track-Guide* mechanism during inspection or maintenance.

Reliability . . . versatility . . . economy . . . strength . . . safety. You name the feature — A-C motor control centers have it. *Ask your A-C representative or distributor for all the facts. Or write* **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wis.*

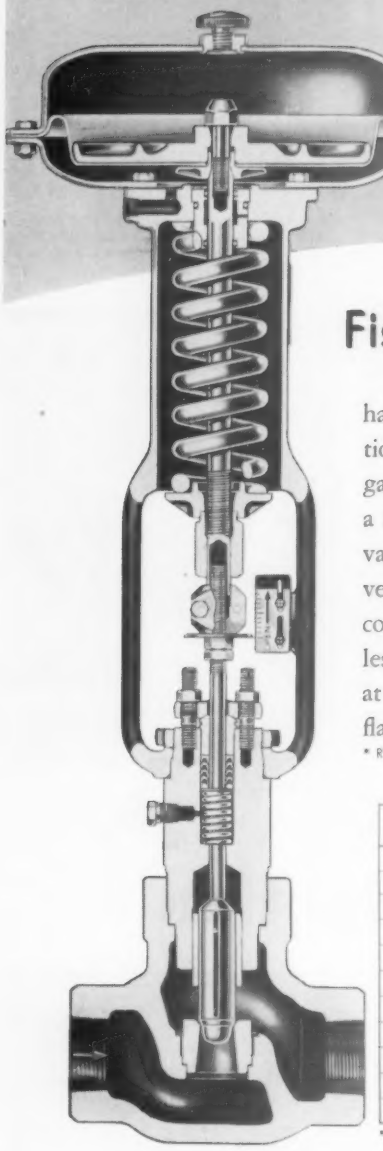
Track-Guide is an Allis-Chalmers trademark. A-1486



6. Mounting of pilot lights and pushbuttons on the removable control units eliminates failures common with hinged wiring.

NO WHIPPING... NO VIBRATION...

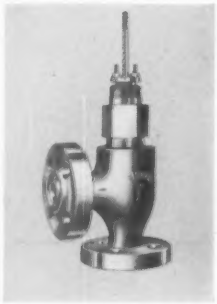
under high pressure drop conditions



Fisher High Pressure Cast Steel "D" Bodies

There's good reason why Fisher "D" bodies have become a standard item in oil and gas production control, and are also widely used in power plant, gas distribution and process industries. Here are just a few: The exclusive Fisher Micro-form Pup inner valve with rigid heavy duty extension guiding prevents whipping or vibration even under highest drop conditions. All "D" bodies are furnished with stainless steel trim and Stellite* on the seating surfaces at *no extra charge.* Can be supplied with screwed, flanged, socket or butt welding ends.

* Registered TM—HAYNES STELLITE



NOW AVAILABLE WITH INTEGRALLY CAST FLANGES

DESIGN "D" AND "DA" BODY AND ORIFICE SIZES

Size, Inches	Body End Connection	Body Pattern	Maximum Working Pressure	Orifice Size, Inches
½, ¾	Screwed	"D" Globe	3600 psi	¼, ⅜, ½
1				¼, ⅜, ½, ¾
1½, 2				¼, ⅜, ½, ¾, 1
1	1500 lb. ASA Flanged			¼, ⅜, ½, ¾
2				¼, ⅜, ½, ¾, 1
1	Screwed or 2500 lb. ASA Flanged	"D" Globe	6000 psi	¼, ⅜, ½, ¾
2*				¼, ⅜, ½, ¾, 1
1	Screwed or 1500 lb. ASA Flanged	"DA" Angle	3600 psi	¼, ⅜, ½, ¾
2				¼, ⅜, ½, ¾, 1
1	Screwed or 2500 lb. ASA Flanged	"DA" Angle	6000 psi	¼, ⅜, ½, ¾
2*				¼, ⅜, ½, ¾, 1

*Also available with 5,000 lb. and 10,000 lb. API flanges.

TYPE 667-D

Write today for further information

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

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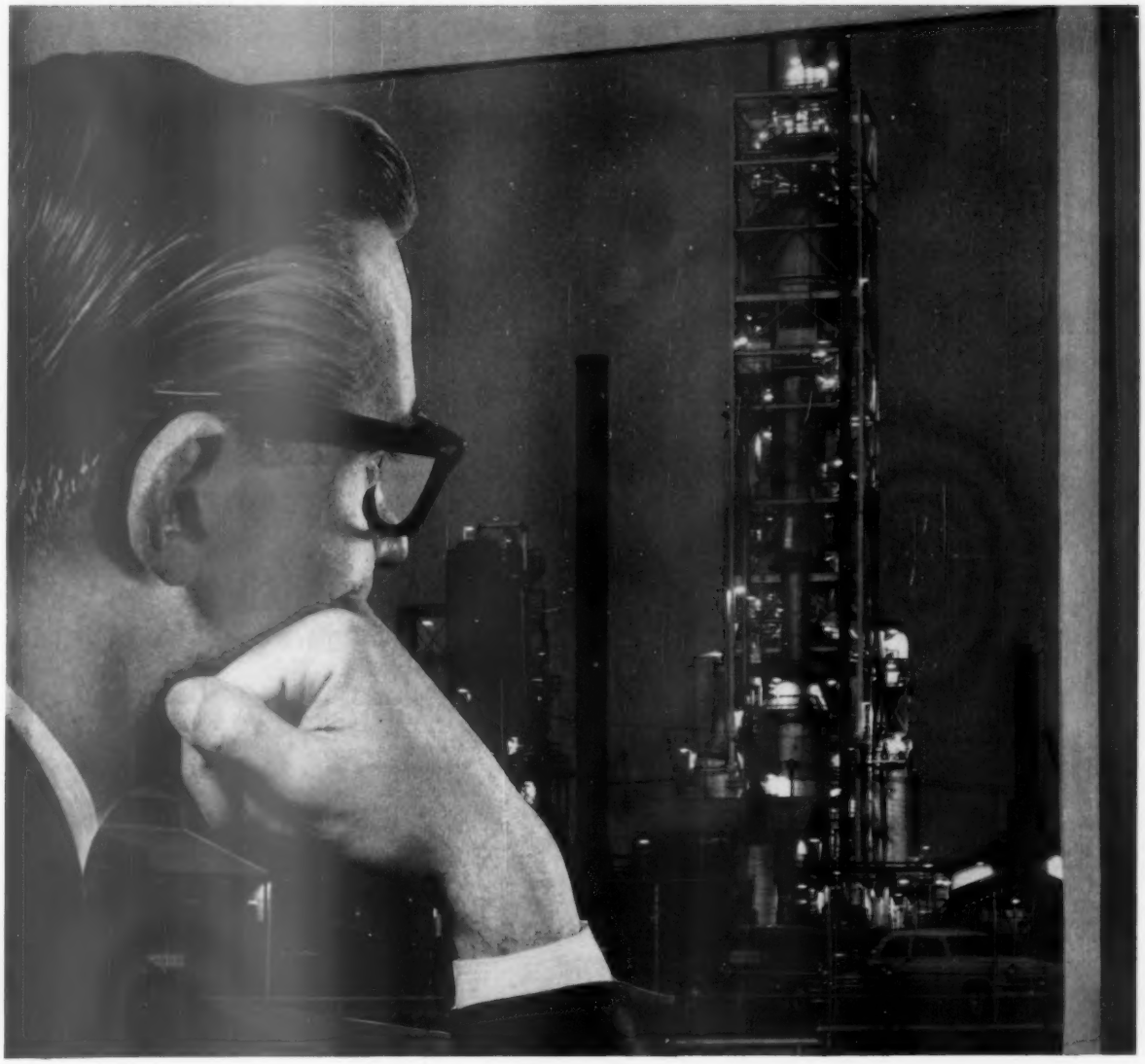
BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIP. CO., CORAOPOLIS, PA.

FISHER® Controls

SINCE 1880

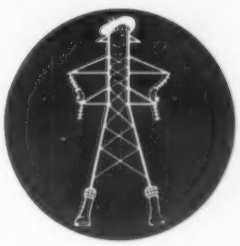


Silent Watchman . . .

Providing around the clock dependability for this clean, modern refinery is the presence of utility electric power. In all phases of operation it holds costs down and also brings greater convenience and the advantages of automatic control. Utility electric power not only provides high continuity of service vital in refinery operation, but it also is so adaptable for individual or special requirements and yet flexible enough for many unforeseen requirements. Call your nearest Utility Electric Power Company today for complete details.

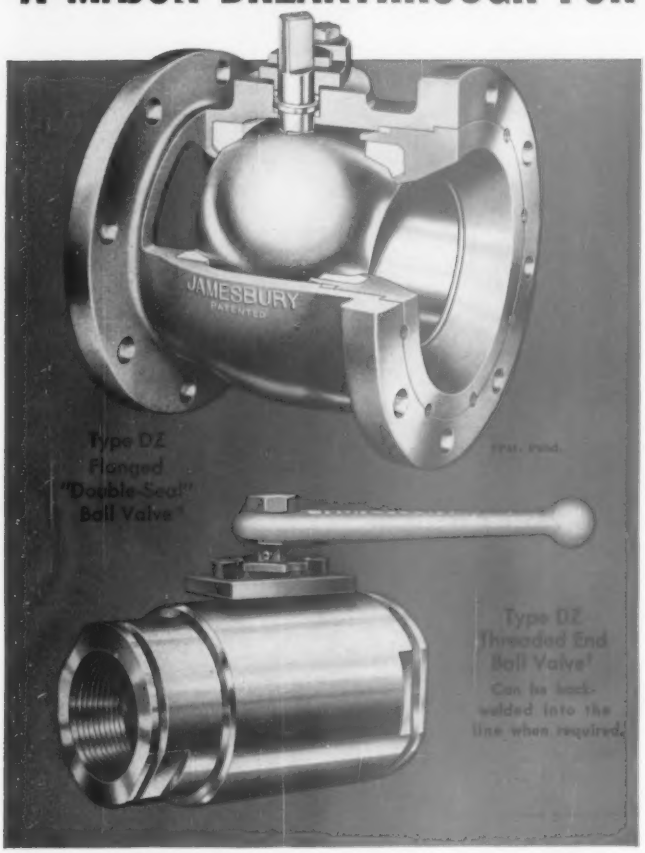
Petroleum Electric Power Association
BOX 35006, DALLAS 35, TEXAS

Utility Electric Power saves money, manpower, maintenance and serves you better automatically



A list of P.E.P.A. members will be furnished on request.

A MAJOR BREAKTHROUGH FOR ON-SITE** PROCESS LINES


JAMESBURY
PATENTED
Type DZ Flanged "Double-Seal" Ball Valve*
Type DZ Threaded End Ball Valve* Can be back-welded into the line when required.

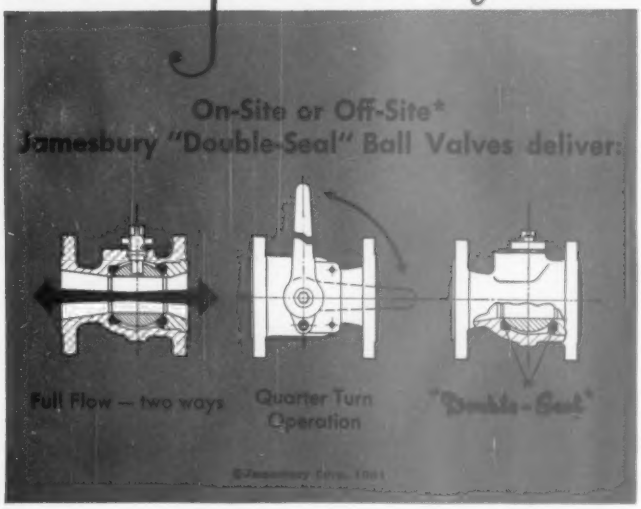
jamesbury "Double-Seal"™ TYPE DZ FIRE*SAFE™ BALL VALVES*

*PATENTED

Meet all relevant API specifications

Now in use in refineries, petrochemical and natural gasoline plants in on-site hydrocarbon service at temperatures below 450°F.

HOW THE jamesbury FIRE*SAFE BALL VALVE OPERATES



In the event of the loss of primary soft seats, a secondary metal seat provides completely effective shut-off of fluid flow.

SIZE RANGE
Type DZ FIRE SAFE Ball Valves

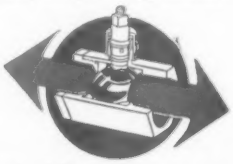
Threaded End: ¼" through 2"

Flanged: 150# series ½" through 12"
300# series ½" through 12" short pattern
*300# series ½" through 8" standard pattern
*10" and 12" on application
*600# series on application

TEMPERATURES AND PRESSURES

From—300°F to 450°F

Differentials dependent on seat material and selection. Consult factory for specific applications.



*Where flamability in off-site piping is not a factor the standard range of threaded and flanged Jamesbury "Double-Seal" Ball Valves is available.

**On-site — within battery limits
Off-site — outside battery limits

Technical literature on request:

JAMESBURY CORP.
95 New Street
Worcester, Mass.
Distributors in Principal Cities

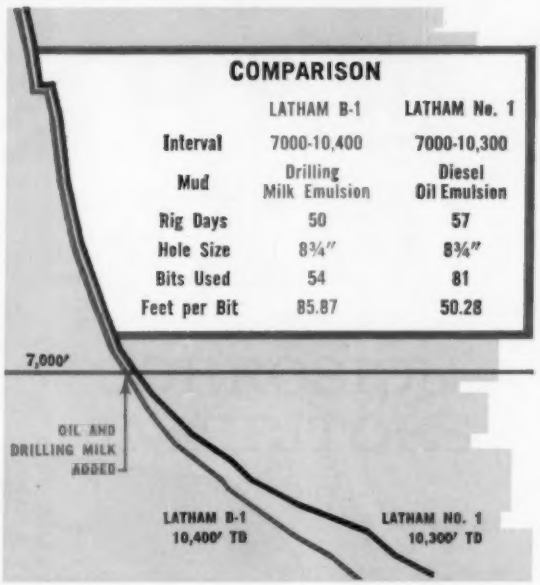
74-1

Fastest Drilled Well Used ATLAS EMULSIFIER

Shell Cuts Drilling Time in Bryan's Mill Field

In the Bryan's Mill Field, Cass County, Texas, a new record for the fastest drilled well was set by Shell Oil Company using an Atlas emulsifier. In drilling Latham B-1, seven days were cut from the previous field record, with a saving of $14,475 in rig time and bit cost.

An inspection of the drilling records for Shell's Latham B-1 and Latham No. 1, the previous fastest drilled well, shows the improvement was made in the interval where the Atlas emulsifier was used. The drilling contractor for the record well, Lecuno Oil Company, had almost identical drilling times and bit consumption from surface to 7,000 feet. At this depth the mud was converted to a low-solids emulsion using an Atlas emulsifier instead of a conventional emulsion mud. Comparing the last 3,300 feet, Latham B-1 was drilled in seven days less time and with 27 fewer bits. Translated into dollars, this represents a saving of $8,400 in rig time and $6,075 in bit cost.

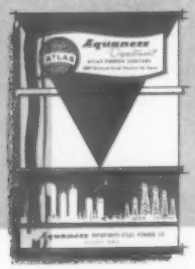


Atlas emulsifier is sold through distributors under these tradenames . . . each is the product of Aquaness Department, Atlas Powder Company:

TRIMULSO®
Distributed by Barold Division, National Lead Company
Registered trademark Barold Division, National Lead Company

Drilling Milk
A SPECIAL EMULSIFIER FOR CLEAR WATER DRILLING AND LOW SOLIDS FLUIDS
MAGNET COVE BARIUM CORP. HOUSTON, TEXAS

DRILLING MILK
Distributed by Magnet Cove Barium Corporation
Registered trademark Magnet Cove Barium Corporation



ATLOSOL
Distributed by Milwhite Mud Sales Company and other selected mud companies
Registered trademark Atlas Powder Company

ATLAS EMULSIFIERS IMPROVE A GOOD DRILLING FLUID
Because Atlas oil-in-water emulsion muds provide better oil action, they improve hole conditions, extend bit life, and increase penetration rates.

Better Hole Conditions. Atlas oil emulsion decreases torque as much as 50% . . . the hole is kept cleaner and pump pressures are correspondingly lower. There is less danger in lost-circulation and low-pressure zones.

Longer Bit Life. Atlas oil emulsion prevents balling, provides better cutter and bearing lubrication. Greatly extended bit life reduces bit costs, reduces rig hours lost to trip time.

Faster Drilling Rates. Atlas oil emulsion makes more feet of hole per hour. Oil lubrication combines with improved hole condition to increase drilling rates in competent and troublesome formations.

ATLAS Aquaness CHEMICALS ATLAS POWDER COMPANY

Aquaness Department, Atlas Powder Company
P. O. Box 21072 • Houston 26, Texas

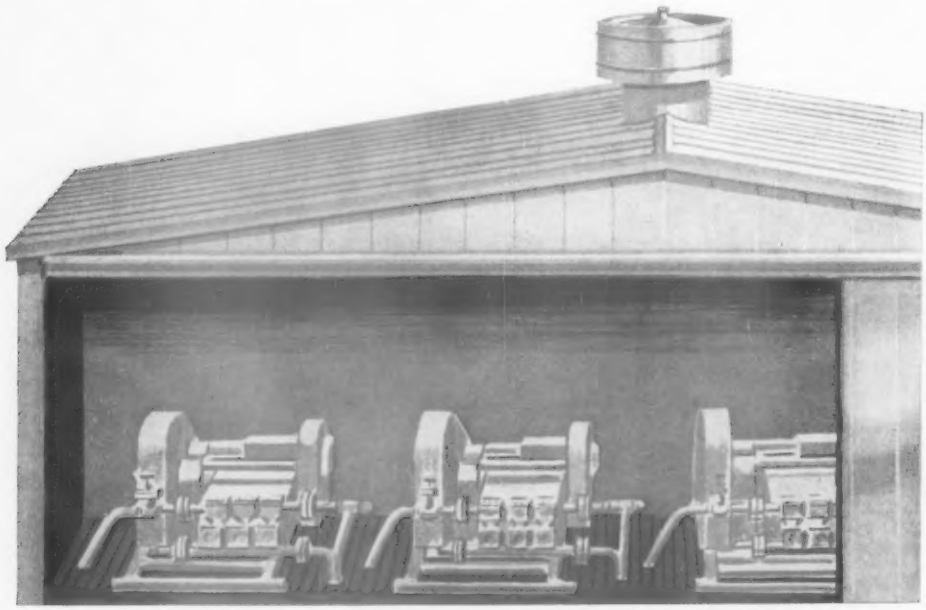
For continuous full-load pumping on waterflood projects

...the rugged Bethlehem Tp

The hardest workers in waterflooding are the injection pumps. Bethlehem's sturdy high-pressure Triplex Plunger pumps will stand up under full-load operation week after week and not miss a stroke. Wherever the pumping is tough—in waterflood systems, pipelines, refineries, salt-water disposal work—you'll find lots of Bethlehem TP's going strong.

Simple construction with controlled flood lubrication makes Bethlehem TP's easy to maintain. And they're readily adaptable to the specific job—plungers and fluid ends are available in a choice of materials. Speed reducers are optional.

Check with the Bethlehem store in your area. If you'd like more information about our rugged TP's first, write for our Booklet 1644, *Bethlehem Power Pumps.*



A SIZE FOR EVERY NEED

Choose between the TP-3, TP-4, and TP-6
Capacities: 100 to 9,565 BPD
Plunger Loads: 3,580 to 10,000 lb
Pressures: 438 to 3,180 psi

For more capacity, investigate Bethlehem's Duplex series, the U-33, UA-46, and U-510
Capacities: 155 to 13,500 BPD
Piston-Rod Loads: 2,400 to 12,000 lb
Pressures: 340 to 1,698 psi

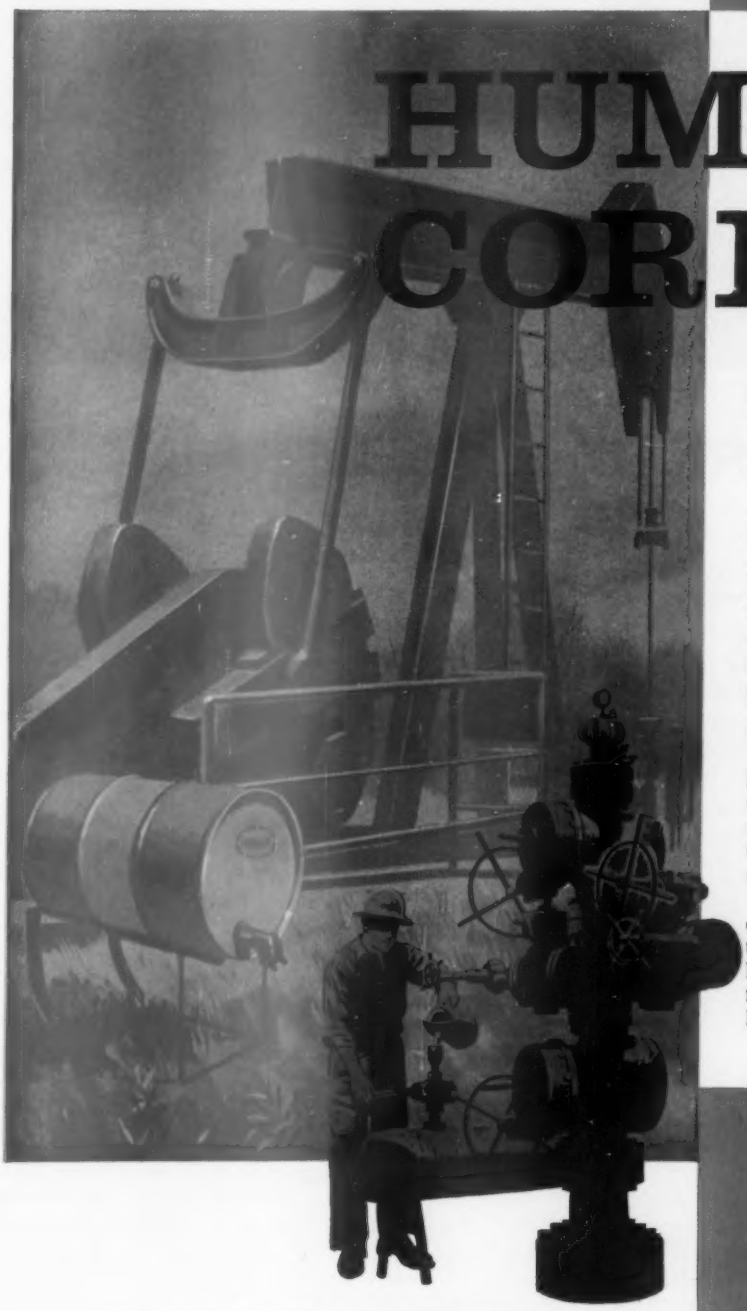
BETHLEHEM STEEL COMPANY, SUPPLY DIVISION
General Offices and Export Dept.: 21 E. Second St., Tulsa, Okla.
Canadian Distributor: Bethlehem Supply Company of Canada, Ltd., Calgary, Alberta, Canada

BETHLEHEM STEEL

BETHLEHEM STEEL SUPPLY DIVISION

Before Corexit: As many as 16 rod jobs on 9 wells in 1 month

After Corexit: Only 4 rod jobs in any 1 year!*



HUMBLE COREXIT®

CORROSION INHIBITORS

* *COREXIT saves $1,010 per well per year* in one field . . . $780 per well in another . . . has proved highly profitable in thousands of wells. In both sour and sweet crude fields, COREXIT corrosion inhibitors prolong life of sub-surface equipment, reduce well-pulling jobs and prevent production losses . . . usually through simple batch treatment.

In deep high pressure, high bottom-hole temperature wells, *squeeze treatment* with COREXIT is opening new opportunities for economical corrosion control. Only a few treatments per year are usually required.

Find out how COREXIT can cut your costs. Call your Humble Salesman, or contact Humble Oil & Refining Company, Houston, Texas. COREXIT is available for immediate delivery from Humble Bulk Plants and other marketers.

HUMBLE

America's Leading ENergy COmpany

BAROID ENGINEERING SOL

Baroid Field Report: Jim Hogg County, Texas

MUD PROBLEM:
Reduce the filtrate loss of an oil that is used as drilling fluid to drill and complete in water-sensitive sands.

WELL DATA

LOCATION: Jim Hogg County, Texas
Total Depth: 2,938'

MUD ADDITIVE PROGRAM

0' to 2918'	Drilled with AQUAGEL* and water. At 2918' set and cemented casing. Cement was drilled from casing, and fluid in hole was displaced with diesel fuel. As diesel fuel was circulated, 5 lb/bbl DURATONE** was added through mud-mixing hopper, followed by addition of about 10% by volume water.
2918' to 2938'	Drilled in open hole using DURATONE, oil and water mixed as above. Well completed and put on pump-production without difficulty.

TYPICAL MUD PROPERTIES

Filtration, API, of this DURATONE-oil-water fluid was 10.1 cc, all oil.

CASING PROGRAM

5½" casing set and cemented at 2918'. Open-hole completion to 2938'.

PROBLEM: To achieve an economical oil-mud with a low filtrate loss that gives maximum protection while drilling in a water-sensitive pay zone.

DISCUSSION: Several wells have been drilled and completed in shallow, water-sensitive Colorado sands in Jim Hogg County, Texas. Open-hole completions were made, and it was thought that considerable formation damage had resulted from water-filtrate invasion. Serious consideration was given to using cable tools for drilling-in, as a means of overcoming this problem.

SOLUTION: DURATONE solved the problem by controlling the filtration of the oil, thus providing an economical oil-base completion fluid that protected the water-sensitive producing sands. Diesel oil, 5 lb/bbl DURATONE, and 10% by volume water were the only materials used. The cost of the DURATONE was $1.80/bbl of finished fluid. Mixing the DURATONE through the hopper while circulating resulted in tight emulsification of the water and a low API all-oil filtrate. Completion was successful, economical, and pump-production was achieved without difficulty.

*REGISTERED TRADEMARK, BAROID DIVISION NATIONAL LEAD COMPANY
**TRADE MARK, BAROID DIVISION NATIONAL LEAD COMPANY

BAROID — *Still Pioneering Drilling Mud Research • Engineering • Marketing*

VES COMPLETION PROBLEM

Economical and successful open-hole completions in water-sensitive sands by use of Baroid's new DURATONE is making this unique product popular in many fields.

In this case history in Jim Hogg County, Texas, completion difficulties and poor production were previously blamed on formation damage by filtrate from conventional water-base muds. A change to cable tool methods for completion was being considered until Baroid's new DURATONE was proposed as a low-cost solution. This drilling-in and completion fluid was made up with diesel oil, 5 lb/bbl DURATONE and 10% by volume water. Drilling was trouble-free and completion was successful.

DURATONE is a dry powdered organophilic colloid that controls filtration of all oil-base mud systems. DURATONE is compatible with crude oil, diesel oil, oil-base emulsions and oil-base muds. DURATONE has been successfully used on drilling, coring, completion and work-over operations. DURATONE improves flow properties, in addition to controlling filtration of oil-base systems at temperatures up to 400 F.

DURATONE oil-fluid additive was developed by Baroid research and engineering to perfect the properties of Baroid's DRILOIL* oil-base mud and INVERMUL* oil-base emulsion mud. Baroid's customer oriented products and services save you drilling and completion dollars and keep these operations on schedule.

BAROID

BAROID DIVISION NATIONAL LEAD COMPANY
MAIN OFFICE: P. O. BOX 1675, HOUSTON 1, TEXAS

6121

They Say—

Case of mistaken identity

Dear Sir:

In your May 22 issue of The Oil and Gas Journal on Page 61 under title "Big Finds Made on Texas, Louisiana Coasts," you list as partners in the Forest Oil Corp. well on Block 129, Vermilion area, the Amerada Petroleum Corp. and Texas Gas Corp. This is written to correct that statement.

Texas Gas Exploration Corp. is the third partner in this venture and not Texas Gas Corp. Texas Gas Exploration Corp. is the wholly-owned producing subsidiary of Texas Gas Transmission Corp. whose headquarters are in Owensboro, Ky. Texas Gas Corp. is a Houston corporation and is engaged primarily in the sale of gasoline products and operates a refinery in Winnie, Tex.

Because of the similarity of names, we have far too often been confused with Texas Gas Corp., and I would just like to set the record straight.

Fred M. Schall, Jr.
Chief Geologist
Texas Gas Exploration Corp.

A high spot

Dear Sir:

I always enjoy reading "Journally Speaking." To me, it attained an all-time high in the May 1 issue ("Thank You, Mr. Carroll," p. 53).

Being a devotee of Lewis Carroll, I couldn't help but applaud the aptness of this article.

F. C. Fellingham
Pan American Petroleum Corp.
Oklahoma City

With both feet, yet

Dear Sir:

Reference is made to Mr. Henry D. Ralph's column "Journally Speaking" in the April 24 issue (Pennies From AAPG," p. 57).

Paragraph 5 states: "To a geologist a well is successful if it has enough of a show to justify setting pipe. Then he's through with it and

the OIL AND GAS JOURNAL

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goes off somewhere else to sit on another drilling well."

The practical oil finding geologist has been plagued with this stigma for years. In times of extreme economic awareness by oil operators, resurrection of this ghost benefits no one. This misconception should not be foisted upon the general public in this manner.

Mr. Ralph should realize by now that he presents a rather ludicrous impression of himself with both feet simultaneously placed in his mouth.

Bill O. Andress
President
Tulsa Geological Society

Trend play coming?

Dear Sir:

Your excellent article on the recent reported oil discovery in Australia (OGJ, May 8, p. 78) raises a number of questions.

It would seem that any gas and oil discovery in Australia would be of potentially greater value than in about any other part of the world today. Because of its isolation, the usual problems of competition and overproduction should have little moment there. Also, this area has a stable government and an industrious, high-standard of living population with a rapidly expanding oil need.

An examination of your map discloses that a line drawn through the new well and the Roma producing gas field passes through the adjoining concession held by Magellan Oil. Is this latter lease in the same structure? And, has Magellan disclosed any of its tests?

L. A. Whitehill
Lubbock, Tex.

We have no way of knowing whether the Magellan Oil Co. lease in Australia is on the same structure as Roma gas field. This would fall under the heading of "classified" information in any oil company file. If you believe in trend play, there certainly exists such a possibility. We know of no tests by Magellan.—Ed.

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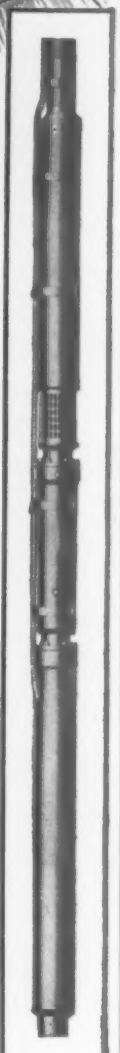

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"I'm not going to suggest that all our problems are solved. But I do say there's no longer any cause for gloom. We can come out of the storm cellars now and start moving ahead again . . ."

Gage Lund, American Petroleum Institute vice president of production, at Pacific Coast district meeting in Los Angeles.

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR OF EVENTS

JUNE

5-6 Petroleum Electric Power Association, meeting, Mayo Hotel, Tulsa.

6-8 Instrument Society of America, summer instrument - automation conference and exhibit, Royal York Hotel and Queen Elizabeth Hall, Toronto.

6-8 Sixth annual Appalachian underground corrosion short course, West Virginia University, School of Mines, Morgantown, W. Va.

9-17 European Congress of Chemical Engineering and Achema Congress, thirteenth exhibition and congress of chemical engineering, Frankfurt am Main, Germany.

11-15 American Society of Mechanical Engineers, summer annual meeting, Statler Hilton Hotel, Los Angeles.

11-15 Air Pollution Control Association, annual meeting, Hotel Commodore, New York City.

11-16 American Petroleum Institute, Division of Production, midyear committee conference, St. Francis Hotel, San Francisco.

12-14 American Petroleum Institute, Division of Transportation, annual tanker conference, Oyster Harbors, Cape Cod, Mass.

12-16 Gordon Research Conferences, petroleum, Colby Junior College, New London, N. H.

13-16 Instrument Society of America, biennial international gas chromatography symposium, Kellogg Center, Michigan State University, East Lansing, Mich.

19-23 Harvard University, School of Public Health, air cleaning institute, Cambridge, Mass.

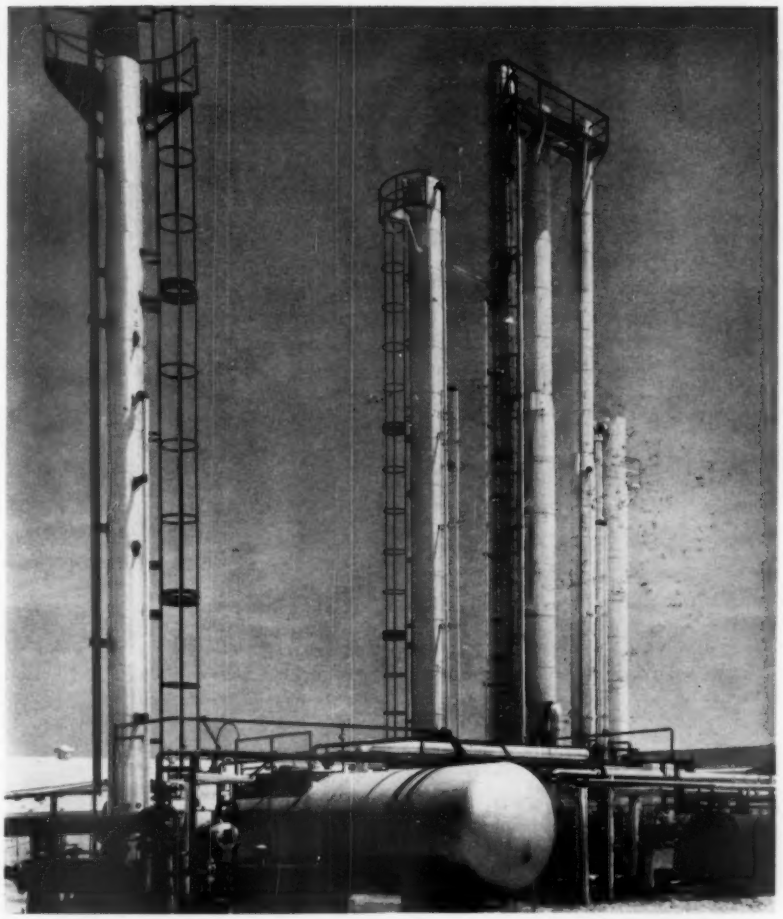
19-23 Gordon Research Conferences, catalysis, Colby Junior College, New London, N. H.

20-22 National Association of Corrosion Engineers, Greater Boston section, corrosion short course, Wentworth Institute, Boston.

20-24 Canadian Gas Association, annual meeting, Banff Springs, Alta.

21-24 American Association of Petroleum Landmen, annual meeting, Shamrock-Hilton Hotel, Houston.

25-30 American Society for Testing Mate-



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rials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

26-27 Michigan Gas Association, annual meeting, Grand Hotel, Mackinac Island, Mich.

26-July 7 Massachusetts Institute of Technology, summer program on dynamics and control of chemical engineering processes, Cambridge, Mass.

28-30 International Gas Conference, Stockholm, Sweden.

28-30 Instrument Society of America, joint automatic control conference, Boulder, Colo.

JULY

4-7 National Society of Professional Engineers, twenty-seventh annual meeting, Olympic Hotel, Seattle.

6-8 International Oil Scouts Association, annual meeting, Roosevelt Hotel, New Orleans.

10-21 University of Michigan, summer course on underground storage of natural gas, Ann Arbor, Mich.

23-28 National Congress of Petroleum Retailers, annual session, Cosmopolitan Hotel, Denver.

26-28 American Petroleum Institute, Division of Production, eastern district meeting, The Greenbrier, White Sulphur Springs, W. Va.

27-29 Rocky Mountain Mineral Law Foundation, seventh annual institute, University of New Mexico, Albuquerque.

AUGUST

2-4 Wyoming Geological Association, sixteenth annual field conference, Green River, Wind River, and Powder River basins.

20-24 Asphalt Institute, international conference on structural design of asphalt pavements, University of Michigan, Ann Arbor.

28-30 Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

28-Sept. 1 American Society of Mechanical Engineers, international heat transfer conference, Boulder, Colo.

SEPTEMBER

5-8 American Chemical Society, Chicago section, eleventh national chemical exposition, International Amphitheatre, Chicago.

7-9 Magic Plains Oil Exposition, Borger, Tex.

11-15 Instrument Society of America, fall instrument - automation conference and exhibit and sixteenth annual meeting, Biltmore Hotel and Memorial Sports Arena, Los Angeles.

12-13 American Gas Association, Southern Gas Association, annual accident prevention conference, Statler Hilton Hotel, Dallas.

13-15 Pacific Coast Gas Association, convention and annual meeting, Coronado Hotel, Coronado, Calif.

13-15 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, annual meeting, Roosevelt Hotel, New Orleans.

13-15 National Petroleum Association, annual meeting, Traymore Hotel, Atlantic City, N. J.

14 Natural Gasoline Association of America, Rocky Mountain regional meeting, Northern Hotel, Billings, Mont.

15-16 Kansas Geological Society, annual field conference, Mark Twain Hotel, Hannibal, Mo.

17-20 American Institute of Electrical Engineers, annual electrical conference of the petroleum industry, Jung Hotel, New Orleans.

18-19 Independent Natural Gas Association

of America, annual meeting, Shamrock Hilton Hotel, Houston.

20-21 Western Petroleum Refiners Association, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

24-27 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Muehlebach Hotel, Kansas City.

25-27 Texas Mid-Continent Oil and Gas Association, annual meeting, Texas Hotel, Fort Worth.

OCTOBER

1-4 American Gas Association, annual convention, Dallas.

3-4 University of Kansas, ninth annual gas measurement institute, National Guard Armory, Liberal, Kans.

4-6 American Association of Oilwell Drilling Contractors, annual meeting, Rice Hotel, Houston.

4-6 American Society of Mechanical Engineers, process-industries conference, Shamrock-Hilton Hotel, Houston.

8-11 Society of Petroleum Engineers of AIME, annual fall meeting, Memorial Auditorium, Dallas.

11-12 Western Petroleum Refiners Association, waste disposal and stream pollution conference, Hotel Lassen, Wichita.

12-13 California Natural Gasoline Association, annual fall meeting, Lafayette Hotel, Long Beach, Calif.

15-17 National Association of Oil Equipment Jobbers, annual convention and trade show, Mayflower Hotel, Washington.

15-18 American Petroleum Credit Association, annual conference, Shamrock-Hilton Hotel, Houston.

17-19 American Society of Mechanical Engineers, American Society of Lubricating Engineers, lubrication conference, Morrison Hotel, Chicago.

18-20 Rocky Mountain Oil and Gas Association, annual convention, Denver-Hilton Hotel, Denver.

18-21 American Association of Petroleum Geologists, Mid-Continent regional meeting, Amarillo, Tex.

24-25 Pennsylvania Grade Crude Oil Association and Pennsylvania State University Mineral Industries Experiment Station, technical conference on oil recovery by solvents, Pennsylvania State University campus, University Park.

25-26 Western Petroleum Refiners Association, annual question and answer session on refining technology, Rufus Garrett Hotel, El Dorado, Ark.

25-27 Gulf Coast Association of Geological Societies, annual meeting, Granada Hotel, San Antonio, Tex.

27 Natural Gasoline Association of America, southern regional meeting, Carlton Hotel, Tyler, Tex.

29-31 Independent Petroleum Association of America, annual meeting, Shamrock-Hilton Hotel, Houston.

29-Nov. 1 National Lubricating Grease Institute, annual meeting, Rice Hotel, Houston.

NOVEMBER

1-3 Southwest Federation of Geological Societies, annual meeting, El Paso, Tex.

2-3 Society of Petroleum Engineers of AIME, annual California regional meeting, Hacienda Motel, Bakersfield, Calif.

2-4 Geological Society of America, annual meeting, Cincinnati, Ohio.

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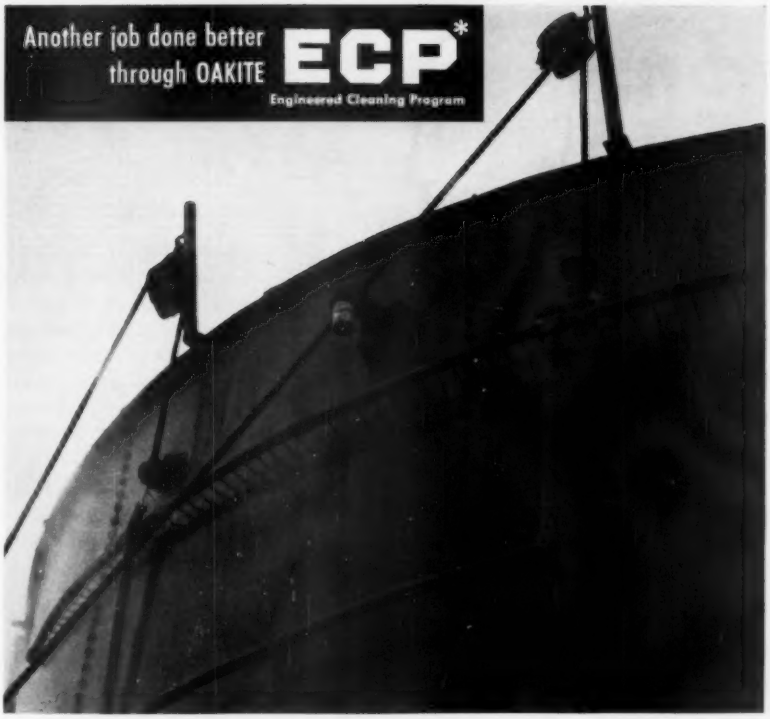

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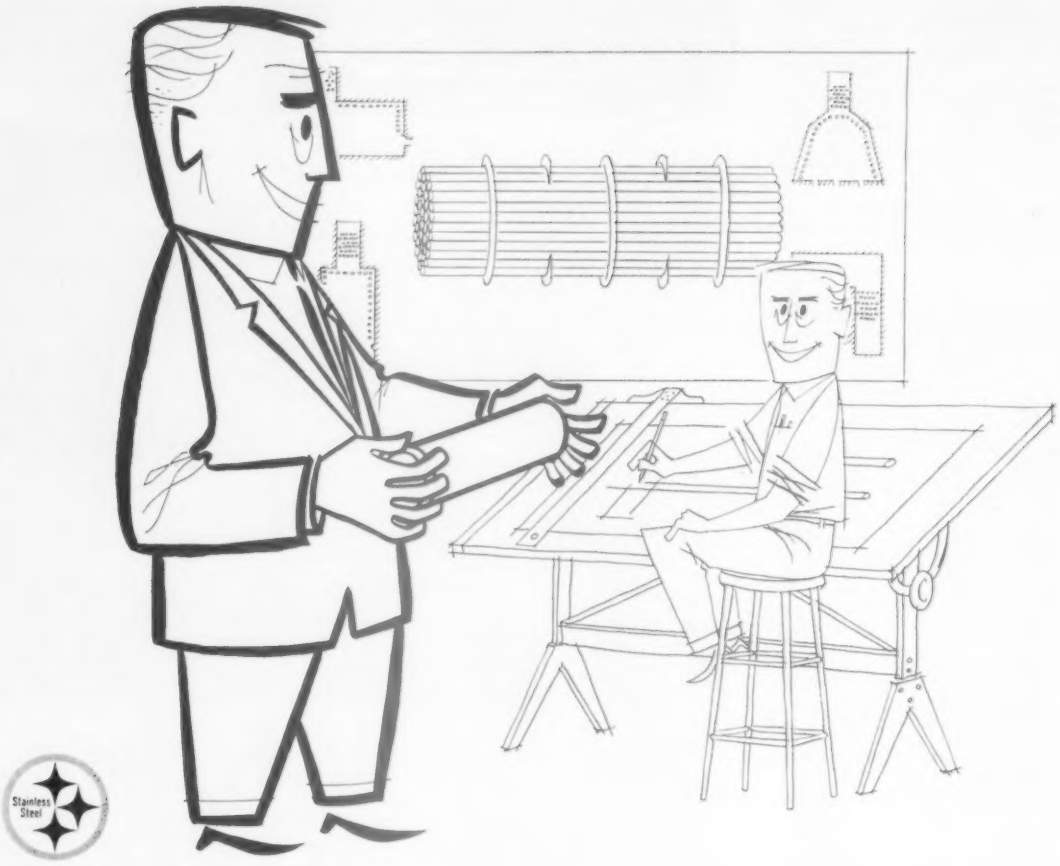

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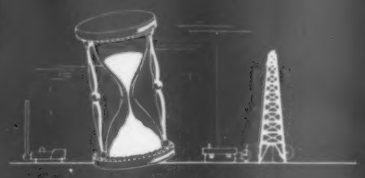

the Journal said...

50 years ago

June 8, 1911

After a long-enforced idleness because of a lease dispute, the Katalla oil fields in Alaska are coming to life again. Amalgamated Development Co., which has bought out the contending claimants, is preparing to make first shipments of oil from the fields by July. Discovered in 1899, the Katalla fields now have four wells.

Road-oiling is starting in earnest in several sections of the country. If the number of towns figuring on using this dust layer find the results satisfactory, substantial inroads into the country's oil supply may be expected.

Producers Oil Co.'s spectacular No. 7 Harrell oil-well fire in the Caddo field of northwestern Louisiana is killed by pumping heavy water and asbestos into the well through holes cut in the casing reached through an underground tunnel.

25 years ago

June 4, 1936

The first permanently equipped pumping-unit barge, developed by The Texas Co., is put in operation in Calcasieu Lake at East Hackberry field, in Cameron Parish, Louisiana Gulf Coast. Its development follows that of submersible drilling barges, introduced by the same company in 1928.

A wildcat test which extends active Clara Driscoll field, southwest of Corpus Christi, in Nueces County, blows out with one of the largest initial oil flows recorded by any well drilled on the lower Texas coast in many years. The well O. W. Killam's 1 Ellick, is making an estimated 2,000 bbl. daily from 3,898 ft.

10 years ago

June 7, 1951

A prize example of the political shenanigans which often face the oil industry occurred in Michigan last week. The legislature increased the state gasoline tax by 1½ cents per gallon. Gov. G. Mennen (Soapy) Williams called a conference of oil companies to propose that they reduce the price of gasoline by an equal amount so that the good people of Michigan would not have to pay any more—hide the tax from the voters, or get someone else to pay it.

World oil prices will eventually break away from their historic basing on quotations at U. S. ports on the Gulf, and Middle East oil will set the schedule for most of Europe and the Eastern Hemisphere. This prediction was made to the World Petroleum Congress at The Hague, by Walter J. Levy, New York consulting economist.

JOURNALLY SPEAKING

The Editorial Page

THIS WEEK this column digresses from its usual format.

There is no attempt at tongue-in-cheek humor or sarcasm, no light-hearted recounting of odd-ball happenings in this fascinating industry.

This week we are playing it straight. What follows is a serious discussion of a serious subject: The Journal's editorial policy as expressed on its formal Editorial Page.

The purpose is to answer many readers who at times are saddened because the Editorial differs with their viewpoint, or perplexed because it treads on tender toes.

So, for the record, here is our Editorial Page philosophy:

The Journal's editorial policy is its own. We wear no man's collar. We are neither "for" nor "against" independents or majors, producers or refiners, international or domestic companies, or any other industry groups which may line up on opposite sides of some question.

We advocate what we think will be for the greatest good of the industry as a whole in the long run. Therefore it is almost impossible to avoid being in disagreement with somebody on any issue. That doesn't worry us. We would rather be respected for our independence than curry favor with a particular group.

We may side with one segment on some issues and against it on others, not because of who it is but because of what we believe to be right. We are often berated for this (seldom in letters; frequently in private conversation). We take pride that an equal number of majors and independents lament that we fail to follow their party line.

The purpose of an editorial page is to make people think. Whether or not we are right on any issue is not nearly so important as that the industry be right in its final determination. If we can stimulate discussion that leads to a constructive course we will have accomplished our purpose even though we may have started off on a wrong tack.

If we simply defended home, motherhood, and the depletion allowance, and never took a stand on a controversial subject, we might as well not have an editorial page. If we offend people it is not to be offensive but to start some soul-searching.

An editorial must be short, pithy, and pointed. It must isolate one single thought for discussion and drive straight to a conclusion about it, ignoring all "on the other hands," qualifications, and extenuating circumstances. Like a lawyer's brief, it should never admit that there is any other side to the case. An editorial that doesn't express an opinion isn't worth writing—or reading.

The Journal's editorials are aimed at the Journal's readers, not at Khrushchev, Kennedy, Congress, or the general public. They discuss subjects specific to this industry, leaving general topics to the general magazines. They are directed to policy makers (and thinkers below that level), and try to give a particular segment of the industry something specific to chew on.

The Journal's editorial policy is to help the industry better serve the nation by correcting its weak spots, not by lauding its virtues.

There you are. That's our credo. It may not make you like any particular Editorial any better, but it may make you understand why the Journal ran it.

—Henry D. Ralph

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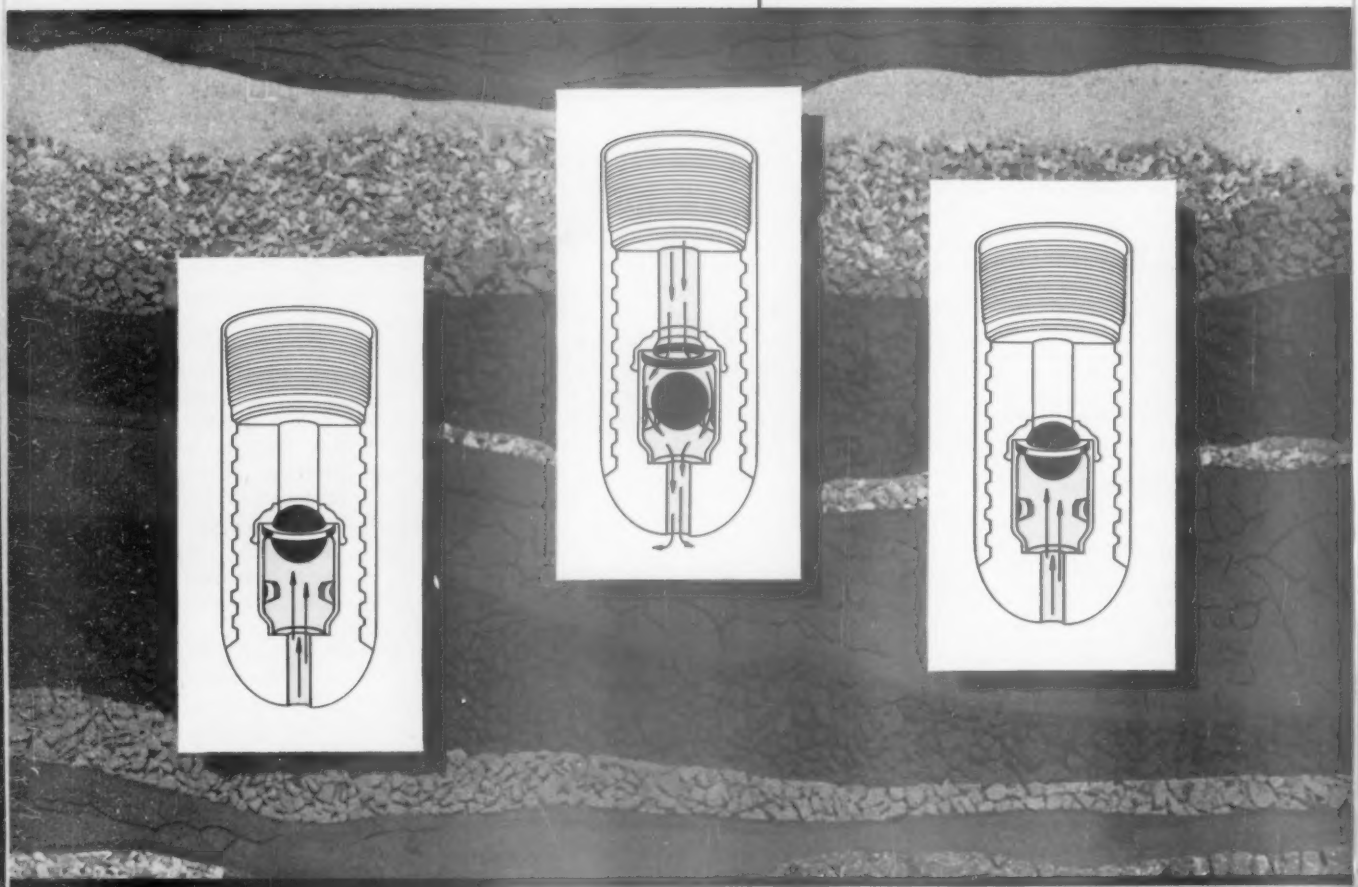

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Depletion now needs an egghead rationale

WHEN THE OIL AND GAS producing industry goes before Congress to defend the 27½% depletion provision—presumably next winter—it will be up against a different type and more formidable opposition than it has ever faced before.

The attack on oil's tax treatment is now spearheaded by "eggheads"—brilliant intellectuals and experts in tax theory, accounting, and economics drawn into public life from academic backgrounds.

The industry must prepare to meet these men on the dueling grounds which they select and with the weapons of their choice.

THE OLD TACTICS won't work any more. Depletion is so complicated that few people understand it thoroughly. So in the past when it was attacked by demagogs or political opportunists the industry could support its position with oversimplified explanations, or (when pressed) could overwhelm the less erudite opponents with technical dissertations on economic theory or accounting practice.

But today's higher critics understand depletion very well—probably better than nine out of ten oil men. They know its theory, its application, and its effects. They know why Congress did what it did about depletion over the years, but they are not influenced by conditions or arguments of the past.

They view tax policy as an instrument of social control and economic guidance. And they believe that the 27½%, plus the expensing of intangible drilling costs, channels too much capital into the drilling of unneeded or uneconomic wells and away from investment ventures which would be of greater benefit to the nation's economy.

They agree with the principle that tax policy should permit the recovery of capital from a wasting asset. But no statistics the industry has yet been able to muster convinces them that 27½%, even as limited by 50% of net, is a just and proper rate.

And they may catch the industry off guard by directing their main attack not against depletion but against the intangibles writeoff as a "double gimmick" which fosters excess producing capacity rather than discovery of new reserves.

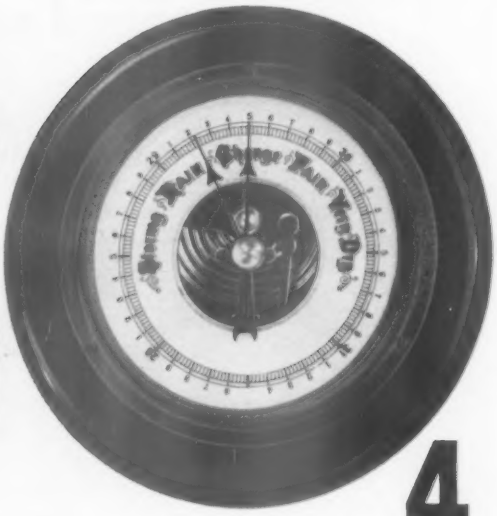
A NEW DEFENSE must be readied by industry spokesmen, a rationale on the egghead level that will expose no chinks for enemy sharpshooters who won't be diverted by emotional orations about the risks of wildcatting or the military value of petroleum.

Its justification of present tax treatment must be supported by ironclad statistics and economic analyses of a depth never before available.

Industry leaders are aware of the challenge. The question is whether the industry will be able to supply the basic statistics and sociological justification to counter the new sophisticated weapons of attack.

Business Barometer:

H_2SO_4



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Olin

CHEMICALS DIVISION

Gasoline Sales Grow in California

Source: Taxable Sales from Calif. Bd. of Equalization.

Majors Gaining in West Coast Market

• All signs point to independents getting smaller share of gasoline market and to Humble, Gulf, and Conoco expanding the "Big Seven" to the "Big Ten." Another pattern: A 1-cent spread between majors and independents.

By Carl J. Lawrence
West Coast Editor

THE BIG Los Angeles gasoline market—nervously coasting along in the wake of a 3-month price war—is trying out a 1-cent spread between independent and major marketers.

Just how long the 1-cent pattern will hold is a question any marketing man in California would like answered. And if it holds, the next question is: Will the new pattern move throughout the West Coast?

A tipoff to whether the spread will reach throughout the area will come from watching the San Francisco market. If it holds there and continues to hold in Los Angeles, then it likely will be adopted throughout the state. And if California makes the break from the historical 2-cent spread, then it's a good bet to move into other Pacific Coast states.

However, the new pattern is far from state-wide. It has not met smooth sailing in San Francisco. At present the San Francisco price structure is fluid. It may settle down to a 1-cent area, but it hasn't yet.

The Los Angeles market, which represents 40% of the state's gasoline sales, has been on the 1-cent pattern for a month, but this is solely on regular gasoline. Regular is selling at 28.9 cents at independent stations — even the serve - yourself outlets — and a penny higher at major stations.

Premium postings vary. Prices range from 30.9 to 34.9 cents. The price shaving on premium sales shows the companies aren't worrying about premium sales. But all are sensitive about regular postings.

It's generally agreed dropping back to the historical 2-cent spread would trigger another price war since some of the majors have fairly well committed themselves to the 1-cent philosophy in Los Angeles.

Adopting the 1-cent spread would be just another step in the trend on the West Coast of the majors trying to get more of the market. And it would be at the expense of the independents. Price advantage is the independents' primary customer attraction. If you cut the spread in half, you're eliminating much of the independents pulling power.

The bitter LA price war was

FORMER INDEPENDENTS—Douglas and Wilshire—were taken over by major companies seeking a portion of the big California market. Continental now controls Douglas and Wilshire is a Gulf subsidiary.

fought over the 1-cent spread. The state attorney general's office reached this conclusion after a 30-day study of the war.

The state found that some of the majors were losing customers to the "so-called independent refiners" controlled by major integrated companies from outside California. No names were mentioned, but obviously the state was referring to Wilshire Oil Co., an old-line independent marketing company taken over last summer by Gulf Oil Corp.

The state reported the majors decided to eliminate the 2-cent spread in an effort to curtail this "new competitive development." The result was the price war which ended with the acceptance—temporarily at least—of the new pattern.

The 'Big Seven' . . . Historically, California's market has been dominated by seven major companies—Standard Oil Co. of California, Shell Oil Co., Union Oil Co., Mobil Oil Co., Richfield Oil Corp., Tidewater Oil Co., and Texaco Inc.

Since 1950 the "Big Seven's" share of the California market has grown from 70% to 78%. The percentage growth for the entire West Coast market has been slightly lower, with the majors currently having approximately 73% of the coast market compared to 27% for the independents.

The majors are expected to gain more of the market. And at least three more majors are ticketed to figure in the picture.

These newcomers are Gulf, Continental Oil Co., and Humble Oil & Refining Co.

Like Gulf, Continental broke into the West Coast market by buying an established independent marketer and refiner, Douglas Oil Co. Humble is moving in by picking up a handful of stations at a time. Humble's growth is probably more by circumstance than choice. The company was bidding for Douglas, but lost out to Conoco.

Douglas was by far the biggest independent marketer and refiner left in California. Continental acquired about 370 outlets in the deal. Douglas would fit the "so-called independent refiner" category mentioned by the attorney general, but the Douglas-Conoco merger was not completed at the time the report was issued.

Humble's move into California has differed from Gulf and Continental in two respects: Humble is converting its new stations to the "Enco" brand and selling at major-station prices.

Both Gulf and Continental are continuing under the old Wilshire and Douglas banners and at independent prices. Both are expected to eventually switch at least part of their outlets to major-brand stations. But neither has indicated when this move will come. Gulf is expected to move first since it has about twice as many stations as Continental.

Gulf, Continental, and Humble won't be taking a market exclusively served by independents. They will lure some customers away from the majors, too. So expanding the "Big Seven" to the "Big Ten" won't be a case of the big getting bigger and the small getting smaller.

The pressure for the 1-cent spread may be relieved once the Wilshire and Douglas stations are converted to major-brand outlets. This would take them out of the catagory of independent marketers controlled by major integrated companies.

Two other majors—Phillips Petroleum Co. and Standard Oil Co. (Ind.)—have been mentioned as candidates for moving into the California market. Phillips made a bold move to buy controlling interest in Union, but ran into Justice Department problems.

Phillips owns 15% of Union's common stock, but can't vote the stock until it settles an antitrust case pending in Los Angeles Federal District Court. If the company wins the court test, then it's logical to assume Phillips might buy more Union stock.

But another angle to this case is that Gulf holds debentures which can be converted into the equivalent

How majors rank in California

(Taxable gasoline sales)

Rank 1960	Rank 1950		% of Market 1950	% of Market 1960	Change
1	1	Standard of Calif.	18.0	**21.2**	+ 3.2
2	4	Shell	8.7	**11.0**	+ 2.3
3	3	Union	11.4	**10.4**	— 1.0
4	2	Mobil	11.6	**10.0**	— 1.6
5	5	Richfield	7.2	**9.1**	+ 1.9
6	6	Tidewater	6.9	**8.5**	+ 1.6
7	7	Texaco	6.4	**8.0**	+ 1.6

How the Big Seven have fared in gasoline sales since 1950

(California taxable sales in millions of gallons)

Companies in order of 1960 sales	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
1. Standard of Calif.*	603.4	682.1	805.4	926.8	937.5	948.5	1,002.3	1,048.0	1,067.4	1,120.0	1,181.8
2. Shell	293.6	397.4	457.9	507.3	561.0	538.1	573.1	597.7	610.6	629.3	663.1
3. Union*	377.2	387.2	417.2	463.0	473.3	497.0	537.2	533.0	547.8	567.4	566.4
4. Mobil	381.6	393.5	419.7	434.1	423.8	478.5	551.5	588.6	571.0	561.8	562.1
5. Richfield*	241.0	282.7	327.6	370.5	388.3	404.0	429.4	447.4	492.0	508.5	522.1
6. Tidewater*	232.9	242.0	250.3	284.7	288.5	292.6	304.0	312.4	337.6	440.7	482.4
7. Texaco	214.8	393.5	273.3	273.3	259.1	289.9	334.9	356.3	393.2	411.2	449.0
7-Company Total	**2,344.5**	**2,628.5**	**2,946.8**	**3,260.0**	**3,331.5**	**3,448.6**	**3,732.6**	**3,883.5**	**4,019.6**	**4,329.0**	**4,397.0**
Total Sales	3,342.2	3,590.0	3,878.3	4,156.5	4,255.3	4,424.1	4,734.1	4,932.7	5,117.7	5,404.8	5,626.3

*Sales from secondary outlets not included in company totals. Source: Calif. Board of Equalization.

of 25% of Union's common. Union hopes to work its way from under the threat of being controlled by Gulf by buying the debentures (OGJ, May 29, p. 114).

Indiana Standard's eagerness to move into California may have cooled. This was indicated when it split the purchase of Honolulu Oil Corp. with Tidewater. Tidewater is getting Honolulu's California properties while Indiana is taking the remainder. At one time, Indiana Standard also was interested in buying Douglas.

But only last week, American Oil Co., the Indiana Standard subsidiary, in kicking off a $100-million national marketing campaign revealed one of its long range goals was expansion into such areas as California, Arizona, and New Mexico (OGJ, May 29, p. 111).

While the newcomers are expanding into California, the established majors are also on the move. Two have expanded their retail outlets in the last 6 months by buying independent chain operations. Tidewater picked up 154 outlets in three purchases and Union 25 in another.

The independents . . . All signs in the West Coast market indicate the independent will be getting less and less of the market in the future.

Two things working against the independent in any market are severe competition from the majors and the trend to expensive, multipump stations. Many independents can't finance the type of multipump station needed to compete in today's market.

There are some elements peculiar to the West Coast which are working against the independents. They are:

. . . The tight domestic crude supply. California is a crude deficit area in which the independents and some of the majors are scrambling for crude supplies.

Independent refiners testifying at the recent import hearings in Los Angeles claimed the majors control or produce 98% of the state's crude. And they blame the tight crude situation on the decrease in the number of independent refiners from 50 in 1940 to 17 today.

Much of the gasoline sold by independent marketers comes from independent refiners. If the trend of the last 20 years continues, this source of supply will dry up within a few years.

. . . High processing costs. Refining costs are high throughout the country, but smog regulations make them a shade higher in Los Angeles. This is another element working against the small refiner selling gasoline to independent stations.

The independent marketer won't disappear in California, but his share of the market is likely to decline. One marketing executive estimates the majors' share of the market will grow from the present 78% to 85% within 5 to 10 years.

Secondary outlets . . . One element of the West Coast marketing picture which differs from the rest of the country is the widespread acceptance of secondary outlets by the majors.

Of the seven majors, four have secondary outlets. Only Mobil, Shell, and Texaco market under one brand name. The secondary outlets are aimed at the independent competition.

All but one of the secondary marketers sell at independent prices. The exception is Standard of California's Signal Oil Co. stations, which is the old marketing arm of Signal Oil & Gas. Standard bought Signal's marketing operations in 1947, which forces Signal Oil & Gas to market under another name in the state.

These secondary outlets always are the target of some criticism from both the pure majors and the independents. One marketing man explains his company's reason for maintaining the secondary outlets with this comment:

"If all the cars were Cadillacs selling at the same price, somebody would want to buy something other than a Cadillac."

The future . . . Marketers are reluctant to make detailed predictions about the West Coast market. They say there are too many elements involved and the market too sensitive to draw a clear picture.

Some things are obvious: The market will grow—taxable sales increased 60% from 1950 to 1961—and the newcomers will continue their efforts to move into the market.

Just how much of the market each company will end up with in 1970 is something that can't be answered from today's statistics. All but two of the seven majors increased their share of the market since 1950—and all are hoping to retain or increase their share in the years ahead.

One marketing official asked about the market outlook for the coast gave this frank reply:

"I don't know all the answers. In fact, I don't even know all the questions."

Push Begins for *MORE* Gas Regulations

• Salvo of vigorous arguments fired in Senate hearing by supporters of bill that would tighten natural-gas regulation. Gist of their contentions: Current confusion over pricing amounts to outright lack of control.

PROPONENTS of tougher, tighter natural-gas regulation have presented their arguments to a Senate committee holding hearings on legislation aimed at that end.

The framework of the bill (S. 666) was drawn up by the National Association of Railroad and Utilities Commissioners (NARUC).

Sen. Warren Magnuson (D.-Wash.) submitted the measure. Similar legislation has been introduced in the House, but no hearings have been started there.

Opponents of the legislation will get their turn before the Senate committee this week.

At the first hearing, advocates of stricter regulation were led chiefly by representatives of several state regulatory agencies. Backing on some points came from the Federal Power Commission itself.

The witnesses complained that gas prices keep going up and up while the backlog of cases at the FPC tends to prevent that agency from determining just what parts of the price hikes, if any, are justified.

For the most part, these people weren't saying that prices are too high. Their arguments boil down to a contention that no one really knows what the prices should be. As they see it, this is tantamount to uncontrolled prices.

What they want, in effect, is something of a freeze on rate increases until the FPC can get around to disposing of the cases on hand. Otherwise, rate increases will keep piling up and the agency will be bogged down for good.

Successive hikes . . . No. 1 target of the bill's proponents is the current provision of the law which permits a rate hike to go into effect after a 5-month suspension if the FPC has not ruled on the proposed increase during that period.

Proponents say the fact that such increases are now collected subject to refund — with interest — is not enough of a deterrent.

They would amend the rule to provide that only one such hike would be permitted. Thereafter, no other rate increase could be collected until FPC had passed on the first one. However, they would give FPC leeway to grant exceptions.

This proposal in S. 666 is not as tough, incidentally, as one in legislation offered recently by Senator John Carroll (D.-Colo.). Carroll would let no increase go into effect until it had been acted on by FPC.

Escalation clauses . . . Another prime target of S. 666: Indefinite-pricing clauses like the "favored-nation" and "spiral-escalation" provisions now found in many contracts.

Advocates of S. 666 are aware that the FPC has already cracked down on some of these provisions. But they want such bans put into law to make sure they stick and to guard them against court challenges.

The bill's defenders argue that escalation clauses have no real connection with costs or value of the gas, but can be triggered by other factors.

"They simply feed the fires of inflation," one spokesman told the Senate committee.

Initial rates . . . The third major aim of the bill's proponents is to require FPC to pass on the price of gas when it is first sold in interstate commerce.

This would result in some form of rate hearing in certificate cases. In the past, the initial rates have not been challenged if proposed projects were found to be in the public interest.

Proponents say this step would write into the Natural Gas Act the Supreme Court's ruling in the Catco case.

"History proves that the Supreme Court changes its official view with great frequency," one spokesman said.

Another spokesman contended that "certificating a sale of natural gas without action to assure that the initial price is consistent with public interest makes regulation thereafter like locking the stable door after the horse has been stolen."

Industrial gas . . . A fourth target of S. 666 concerns industrial sales. The proposed legislation would repeal the present prohibition against suspension of rate changes involving sales of natural gas for resale for industrial use.

Advocates of the change say the present exemption of sales for industrial use is a loophole which "frustrates to a great extent efficient

What Proposed Gas Bill Would Do

PRINCIPAL proposals in a pending Senate bill (S. 666) affecting natural-gas regulation would:

- Outlaw certain types of indefinite-pricing clauses in natural-gas contracts.
- Give FPC jurisdiction over sales of natural gas for resale for industrial use.
- Prevent successive rate increases when the initial rate hike is still pending.
- Require FPC to make a specific finding of "public interest" in rates proposed in certificate cases.
- Require FPC examiners and commissioners to act within a specified time after a case is opened.

regulation of natural-gas companies."

Finally S. 666 would require decisions by FPC hearing examiners and by the commissioners themselves within a specified time. The obvious intent is to force FPC into action.

FPC views . . . FPC Chairman Jerome Kuykendall, who will appear before the committee this week, has already submitted a written statement in which he said the commission supports most of the aims of S. 666.

He pointed out that the commission has recommended to Congress time and again that it outlaw certain types of indefinite-pricing clauses and lift the prohibition against suspension of industrial sales.

Kuykendall emphasized, however, that the commission is opposed to outlawing all indefinite - escalation clauses. He said this would be too restrictive and that the FPC should be able to permit price redetermination under "controlled" conditions.

Kuykendall said he opposes the S. 666 section requiring action by a specified deadline. He said he approves the purpose of the proposal, but feels that it would be better to depend on the judgment of the commission to determine how quickly a case should be handled.

He questioned the need for the requirement that action on initial rates be written into law. This isn't necessary, he said.

Kuykendall also suggested that the proposal relating to successive rate increases should be limited to interstate pipelines and should not be applied to producers.

There was one other note of cheer to producers in the FPC views as expressed by Kuykendall.

He said flatly that the commission feels that many of the public-utility features of the Natural Gas Act should be eliminated in the regulation of producers.

"Congress should consider specifically the question of a rate formula applicable to independent producers and to production of natural gas for interstate transportation and sale," he said.

Kuykendall did not specify area pricing or any other particular formula, but simply stressed the need for getting away from utility-type regulation of producers.

watching WASHINGTON

Clyde La Motte

• Consumer groups, producers agree there is a snafu . . .

THERE IS at least one major point of agreement between state utility commissioners and independent producers: The present system of natural-gas regulation is pretty hopeless.

State officials appearing before a Senate committee recently kept stressing the uncertainty and chaos resulting from the pile-up of cases at the Federal Power Commission (see p. 36).

They cited instance after instance of rate hikes made as far back as 1955 that are still unsettled. Meanwhile, additional rate hikes have piled atop the original one. Lumped, they total hundreds of millions of dollars in unsettled rates.

This means that the distributing companies and the consumers don't really know what they have been paying or will be paying for natural gas.

Such a situation, said California's Gov. Pat Brown, "is indefensible judged by any man's reasoning."

Producers know just what he means, for many have been selling gas for years without knowing what they would be paid. This, too, is indefensible.

• Point of disagreement: What should be done now? . . .

THE DIFFERENCE in the views of these state commissioners and most segments of the industry lies in what should be done to correct this absurd situation.

In the bill the commissioners have proposed to Congress (S. 666), state officials suggest this "cure": Don't permit a rate hike to be filed if an earlier rate case is still pending before the FPC.

They figure such a move would slow down the filing of rate cases and thereby permit the beleaguered FPC to catch up.

Realizing that such a mandatory limitation might be subject to legal challenge, they would grant the FPC authority to make exceptions.

Many producers and others feel that this is approaching the problem from the wrong end. There is obvious inequity in blocking a producer or a pipeline company from a rate hike it deserves simply because the FPC can't get around to a case.

They figure that the best and quickest way to cut down the FPC backlog would be to eliminate the thousands of cases that shouldn't be before the agency in the first place—the independent-producer rate cases.

• Don't look to Congress for any solution soon . . .

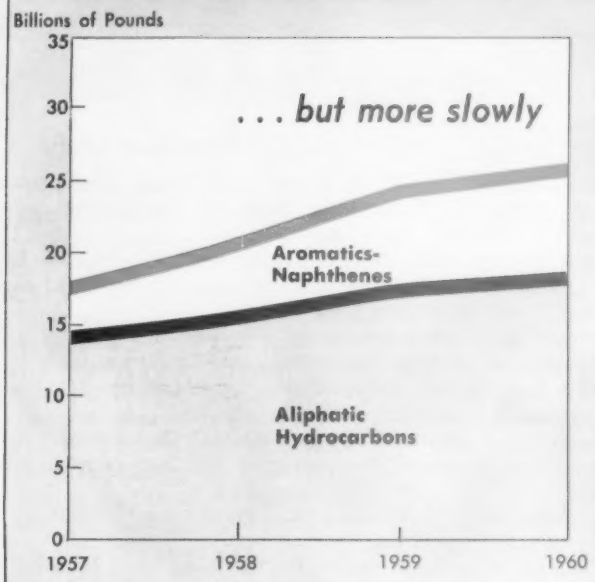
CONGRESS is a long way from deciding what it should do about the gas regulatory mess.

It is entirely possible that the Senate Commerce Committee may adopt some if not all of the proposals made by the National Association of Railway and Utility Commissioners. A nose count of committee members shows that a majority are from states whose utility commissioners support S. 666.

The bill might win approval by the full Senate before the summer ends. Even so, it will face rough going in the House.

The best guess at this point is that S. 666 will bog down somewhere along the line. Thus, unless some other approach suddenly catches fire, little or nothing will be done by Congress this year, and the problem will be allowed to fester for another year.

Petrochemical Output Still Growing . . .



PRODUCTION BY MAJOR PRODUCTS

(Thousands of pounds)

	1960	1959	1958
AROMATICS AND NAPHTHENES			
Distillates and solvents	1,464,256	1,629,831	1,271,785
Benzene	2,266,509	1,530,423	1,041,659
Cresylic acid	36,442	37,888	38,078
Naphthenic acid	23,801	19,843	18,961
Toluene	1,743,160	1,817,095	1,501,337
Xylene	1,975,662	1,683,239	1,380,773
All others	39,562	31,508	32,341
Total	7,549,392	6,749,827	5,284,934
ALIPHATIC HYDROCARBONS			
C_2 hydrocarbons	6,182,037	5,789,638	4,795,322
C_3 hydrocarbons	5,413,866	5,488,679	5,035,744
C_4 hydrocarbons	4,772,459	4,698,230	4,294,619
C_5 hydrocarbons	88,480	100,452	171,524
All others	2,102,127	1,594,874	1,321,356
Total	18,558,969	17,671,873	15,618,565
Grand Total	26,108,361	24,421,700	20,903,499

Aromatics, Naphthenes Score Largest Gain

PETROCHEMICALS set new production records again last year but growth rate is tapering off.

After a 16% increase in 1959, production of basic organic chemicals from petroleum and natural gas was up only 7% last year.

The largest gain was made by aromatic and naphthenic products.

Sales last year were up, but the increase amounted to a mere 6%. This compares with a whopping 40% gain the year before.

Despite reduced production and sales, the future still looks bright for petrochemicals and new records are expected this year.

All in all, it appears the petrochemical industry is settling down for a period of steady growth and any spectacular gains in the future will be limited to specific product groups.

The U. S. Tariff Commission has issued a preliminary report on last year's slowdown in petrochemical advances. It shows that U. S. production of organic products from petroleum and natural gas totaled 26,108 million pounds compared with 24,422 million pounds in 1959.

Aromatics and naphthenes . . . These products accounted for 7,549 million pounds of the 1960 production.

Benzene, outstanding performer in the group, rose to 2,266 million pounds—a 48% gain. This is just about the same rate of increase that was registered in 1959.

Xylene production also matched its showing of the previous year. The increase was 17%, pushing production to 1,976 million pounds.

The bottom seems to have dropped out of the toluene boom. Toluene has fallen to third place behind benzene and xylene as the large-volume aromatic, after leading for several years.

Production of toluene totaled 1,743 million pounds last year, a drop of about 4%.

The reason for the decline is obvious: The biggest use of toluene is in blending processes for aviation and motor gasolines, and the aviation-gasoline market was down almost 22% in 1960. It probably will decline further this year.

However, producers hope an increased demand for toluene to dealkylate into benzene will help offset this loss.

There was one bright spot in the toluene picture: Sales increased 21% to 1,199 million pounds. Benzene sales also chalked up a 21% gain, rising to 1,752 million pounds.

Aliphatics . . . This huge product

INDUSTRY

Oklahoma's June allowable was cut from 15 to 13 bbl. daily per well by the state corporation commission. The allowable is expected to produce 515,000 bbl. daily compared with average production in the first 20 days of May of 527,000 bbl. daily. Oklahoma crude buyers had nominated 506,210 bbl. daily for June while the Bureau of Mines demand estimate was 525,000 bbl. daily.

Purchase of assets of Three States Natural Gas by Delhi-Taylor Oil has been completed. A production payment of $10,182,000 reserved by Three States has been sold to New York Life Insurance Co. to retire the company's existing indebtedness. Cost of the purchase to Delhi was 1,365,526 shares of its

group had a total production of 18,559 million pounds in 1960 against 17,672 million pounds in the previous year.

Ethylene continues to be the largest volume product with almost 5.5 billion pounds being produced last year—a 7% rise over 1959.

But propylene was the biggest gainer with a production of 2,477 million pounds, up 15%.

Propylene also made the biggest gains in sales with a 30% increase to 1,365 million pounds. Ethylene increased 10% to 3,252 million pounds and a 2% decline in butadiene sales brought the level to 1,074 million pounds.

Production of butadiene hit a record 1,883 million pounds. This compares with 1,816 million pounds in 1959.

Texas Tax-Hike Effort Fails

- **Legislature quits without okaying gas-production tax boost. But special session may see renewal of issue.**

EFFORTS to hike current high taxes on the Texas oil and gas industry flopped last week when the fifty-seventh session of the Texas legislature adjourned without passing a tax bill.

Only a tie vote in the House, however, prevented submission to the governor of a "temporary" hike in the gas-production tax to 8% of value from the present 7%.

The gas-tax hike was an appendage to a general-sales-tax bill killed by the House deadlock in the last hour of the session.

But the fight is not yet over. A special session of the legislature will convene July 10 to deal with the unfinished tax problem.

Other casualties . . . Several other bills of special interest to the industry died after getting hung up in the adjournment machinery.

One was a controversial gas-proration measure. It would have written into law a proration formula apportioning at least one-third of a gas field's total allowable in equal shares to all wells in the field, no matter what their spacing.

Another bill which would have set up a powerful state water-pollution-control board died in the Senate.

Some win out . . . A number of oil and gas measures barely skimped through in the last days of the session. They included bills to:

. . . Extend leases which have shut-in gas wells past their primary terms under certain conditions. This one already has been signed into law by Gov. Price Daniel. It was effective immediately.

. . . Require state agencies, including the Railroad Commission, to file certified copies of the rules they adopt with the secretary of state within 90 days. There they would be available for public inspection.

. . . Amend the LPG code to make it clear that the code does not apply to pipeline companies. It will be effective when signed by the governor.

. . . Allow insurance firms (life, health, and accident companies) to invest up to 10% of their assets in oil-and-gas-production payments. Effective when signed by the governor.

. . . Set up regulations governing the labeling of petroleum products.

. . . Require the Railroad Commission to give advance notice of intent to hold a hearing on field rules for an oil or gas field in a newspaper in the county where the field is located.

. . . Make it a felony to steal geological or geophysical maps.

The last three bills are awaiting the governor's signature.

BRIEFS . . .

common stock, but since it already held 41% interest in Three States only 808,087 shares were issued for the assets.

A new area office in Dallas will be opened by Humble Oil & Refining early in July. About 1,000 persons will be employed by the new headquarters which will direct exploration, production, and marketing operations over an 85-county area in East, North, and West Central Texas.

District exploration offices of Sun Oil are being closed in Salt Lake City, Bismarck, S. D., and Durango, Calif. But a company official says there will be no curtailment in the staff of geologists and land men.

Purchase of 1,000,000 shares in Mill Creek Oil Co., Ltd., Calgary, gives Founders Corp., New York, 40% of the Canadian firm's stock. Mill Creek owns about 20% of the stock in Can-Amera Oil Sands Development Ltd., a company which has several thousand acres of the tar sands under lease.

The New Mexico Conservation Commission will keep June production allowables at the May levels—34 bbl. daily for southeastern fields and 70 bbl. daily for the San Juan basin. This means an estimated allowable of 313,343 bbl. daily in the southeast and 56,452 bbl. daily in San Juan basin.

Kansas Corporation Commission has set June crude production allowable at 300,000 bbl. daily, the same as for May. Buyers of Kansas crude had nominated 292,973 bbl. daily while Bureau of Mines demand estimate for the state was 310,000 bbl. daily.

A study of magnetic and gravitational fields along the buried Ouachita Fold belt in Central Texas will be carried out by Dr. William R. Muehlberger, University of Texas geologist, under a grant from the National Science Foundation. In the studies, Muehlberger will attempt to determine major structures and types of rocks in an area bounded by Taylor, Lampasas, Marble Falls, and Austin.

Alberta has set a new high for daily average crude production for the week ended May 15 of 474,784 bbl. This tops the previous high set in January 1957 by 6,627 bbl. daily.

Russians Eager to Impress U. S. Gas

• July tour will give Americans sweeping look at Soviet Union's awakening gas industry. Their hosts are proud of many things—especially research.

WHEN an American delegation gets its first look at Russian gas operations next month, it will find a potentially vast industry poised for a great leap forward.

An eight-man delegation is scheduled to start a month's tour of the Soviet Union July 2, immediately after attending the International Gas Conference in Stockholm. A U. S. tour by Russian gas experts, originally scheduled last month, has been tentatively reset for September.

The reciprocal visits will be the first for the gas industry under a scientific and cultural exchange agreement signed in 1959. Tours will be sponsored by the American Gas Association in cooperation with the State Department.

Both nations conducted oil tours last year. An American group went to Russia in August and a Russian delegation visited the U. S. in October and November.

The American gas men can expect to see an industry that is still in its infancy.

All of Russia at this time has production only roughly equal to that of the top U. S. producing company. But recent discoveries place some Russian fields along side the world's largest, and plans for exploiting them signal a big gas-transmission boom.

The ambitious development program will assure the Americans of at least one sight they have never seen before. Crews working on the construction of parallel 40-in. gas pipelines, each with ultimate capacity of a billion cubic feet daily (OGJ, May 29, p. 118).

This is the largest diameter pipe ever used for high-pressure long-distance transmission of either oil or natural gas.

Who's going to Russia . . . The U. S. is sending a blue-ribbon group representing all branches of gas from research to regulation.

The delegation includes:

. . . **Baxter D. Goodrich** senior vice president of Texas Eastern Transmission Corp., Shreveport, La. Formerly a chief engineer, Goodrich is regarded as a bold innovator with one of the top technical minds in the transmission industry. He was the force behind Texas Eastern's development of the centrifugal compressor for high-pressure transmission of natural gas, and the use of unusually large power packages—both gas turbine and electric motor—to drive them.

. . . **Fred W. Batten,** vice president of Columbia Gas System, Inc., New York, the nation's largest gas distributor with integrated operations from exploration to distribution. Batten, chief operations officer of Columbia, is in charge of production, transmission, and distribution of natural gas, and extraction of hydrocarbons.

. . . **Robert B. Stewart,** vice president and head of the natural-gas department of Phillips Petroleum Co., Bartlesville, Okla., the nation's largest producer of natural gas.

. . . **E. H. Smoker,** president, United Gas Improvement Co., Philadelphia. Smoker is also first vice president of AGA and is in line for elevation to the presidency next year.

. . . **Paul W. Kraeamer,** vice president in charge of operations for Minneapolis Gas Co., Minneapolis. Holder of chemical-engineering and law degrees, plus a diesel-engineering certificate, he is a member of AGA's general-research-planning committee.

. . . **Henry A. Eddins,** president, Oklahoma Natural Gas Co., Tulsa, a pioneer integrated company engaged in all phases of natural-gas operations.

. . . **Samuel J. Cunningham,** senior research engineer for AGA in New York. He is in charge of AGA research in the pipeline and transmission fields.

. . . **William R. Connole,** Washington attorney and former member of the Federal Power Commission.

What they'll see . . . In Russia the Americans will get an insight into a sprawling state-owned industry planned and operated by a single bureaucracy.

They will see a monolithic enter-

Where Delegates Will Go in Russia, U. S.

American Itinerary Starting July 2

All-Union Institute of Natural Gas Research, Moscow.

Inspection of Moscow gas-distribution system.

Ukraine State Gas Planning and Designing Institute.

Gas field and gasoline plant in Shebelinka, Eastern Ukraine, and Shkapovo and Minnebayevo fields in Bashkir.

Prospecting techniques and storage in Stavropol gas fields.

City distribution system and butane plant in Leningrad.

Russian Itinerary in September

American Gas Association, New York City.

Federal Power Commission and Bureau of Mines, Washington.

Peoples Gas Light & Coke Co. distribution system and Institute of Gas Technology, Chicago.

Lone Star Gas Co., Dallas; Phillips Petroleum Co., Amarillo; Texas Eastern Transmission Corp., Houston; and Transcontinental Gas Pipe Line Corp., Houston.

United Gas Improvement Co.'s Philadelphia Gas Works.

Delegation

prise whose energy role is part of an over-all state plan of end-use control. The strategy behind the current stepped-up development is to free crude oil for export.

Crude is Russia's most negotiable export commodity. It provides the means to buy machines for industrialization at home and to achieve economic and political penetration abroad.

The heart of Russia's natural-gas expansion is the 40-in. project.

On the tour the American gas men will see what is, by Russian accounts, the most mechanized field-welding operation in any country.

Automatic welding in the field is just being introduced in the U. S. But the Russians claim to have been making practically all field welds automatically for some 5 years. They have offered their automatic flash-welding equipment for sale in the West.

The Soviets say the research institutes they will show off are second to none. All design and field problems in the industry are handled in these institutes.

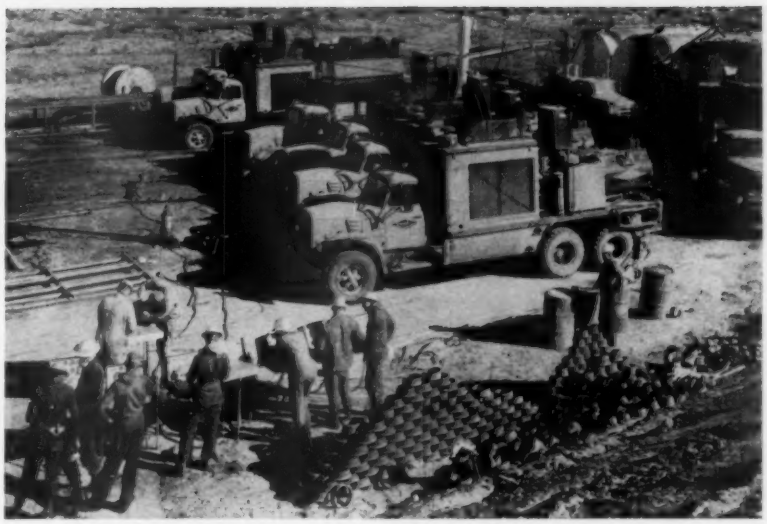
The Russians are also proud of their beginnings in automation, although they readily admit to lagging in this area.

What Russians will see . . . The Russians this September will see similar U. S. installations, and then some.

At their request, they will tour a liquefied-petroleum-gas-pipeline operation. It will be Texas Eastern's Little Big Inch, a products system which batches LPG and has extensive underground-storage facilities.

They will also see the distribution systems of Chicago and Philadelphia; construction projects, both marine and dry land, with large-diameter pipe; and two types of underground storage, an aquifer reservoir near Chicago and a depleted field in Texas.

They will visit two gasoline plants in Texas; producing facilities in the Panhandle-Hugoton field — largest in the U. S.—in Texas; two compressor stations and dispatching centers; and two research centers.



SIX PUMPER trucks work on Atlantic Refining's Lucas State 1 as . . .

Fracturing Depth Mark Set

THE WORLD'S deepest fracturing job has been completed in a West Texas well.

Dowell Division of Dow Chemical Co. treated the Atlantic Refining Co.'s Lucas State 1, 25 miles west of Fort Stockton, Tex., through perforations from 16,030 to 16,210 ft. in the Devonian formation.

Total well depth was 17,015 ft.

The well was treated with 145,000 gal. of gelled water and 80,000 lb. of sand at a rate of 33 bbl. per minute down the casing. Maximum surface pressure was 3,500 psi.

Bottom-hole temperature of the well was about 270° and the treating fluid was heated to 160° before being injected. The aim was to prevent damage to the cement from contraction and subsequent expansion that would be caused by cold liquid encountering such a high temperature.

Six pumper trucks and auxiliary equipment were used in the treatment.

The deepest fracture treatment before this was carried out several months ago in the British-American Producing Co.'s Vera D. Hussy 1-X near Lindsay, Okla.

Western Co. handled the Oklahoma treatment through perforations open from 15,358 to 15,836 ft. Total well depth was 15,860 ft.

Study Launched on Texas Regulations

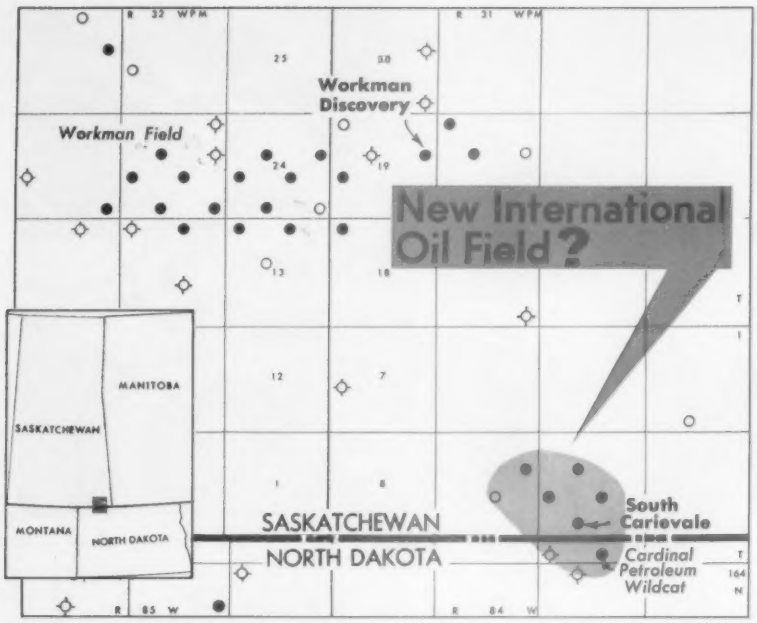
THE FIRST comprehensive study of Texas oil and gas regulations in many years has been launched by the West Central Texas Oil and Gas Association.

An 11-man committee is headed by J. S. Lauderdale of Abilene.

Sam L. Robertson, association president, says the prime reason for the study is "the feeling by many people in the industry that Texas regulations need modernizing to encourage greater economy, bring exploration capital back into the state, and help the state regain its rightful share of the market."

Other committee members:

E. T. Adair, Texas Pacific Coal & Oil, Fort Worth; E. L. Anders, Leclair Operating Co., Abilene; J. P. Dunigan, Daya Operating Co., Abilene; Harry W. Elliott, Jr., Nueve Operating Co., Abilene; P. S. Ervin, Ervin Secondary Recovery Co., Abilene; Tom Gordon, Abilene independent; O. H. Reaugh, Graridge Corp., Breckenridge; James E. Russell, Russell Engineering, Abilene; E. Bruce Street, Graridge Corp., Graham; and William N. Tindell, Mayfair Minerals, Inc., Abilene.



Pool May Straddle Border

IT LOOKS as if the United States and Canada may have their first "international" oil field.

Good oil recoveries have been made on drill-stem tests of a wildcat in Renville County, North Dakota.

Successful completion would extend Saskatchewan's South Carievale field across the border.

The wildcat, Cardinal-Petroleum Co.-North American Royalties, Inc.-Sun Oil Co. Aubrey Harkness 1, SE SW 28-164n-84w, is 660 ft. south of the international line. Recoveries were made at 3,877-89, 3,991-4,012, and 4,011-36 ft. in the Mississippian. Top of the Midale zone is 3,881 ft.

Operators are running casing.

The South Carievale field was opened in March by Kissinger Petroleums, Ltd.'s South Carievale 3-4. That well flowed 25 bbl. per hour during tests.

Since then, Kissinger has completed four wells and Imperial Oil, Ltd., has completed one. An unsuccessful effort was made to complete a well in North Dakota some weeks ago.

South Carievale could develop into a field as big and productive as Workman, 5 miles to the northwest. There, a 1960 Kissinger discovery kicked off development of a field which now has 20 producing wells.

All of the Workman wells have made good flows from the Mississippian.

Up to now, the closest North Dakota production has been at Sherwood field, 8 miles southwest of Workman.

High price expected for choice block in California tidelands

A 4,250-ACRE block which adjoins the highest-priced acreage in offshore leasing history will be offered by California in September.

The new acreage is known as Parcel 4. It is off Santa Barbara County to the east of Parcel D, which is leased by Texaco Inc. and Newmont Oil Co. Parcel D brought a record bonus bid of $23,711,538, or $6,175 an acre, in 1958.

Texaco has discovered Caurta field on the expensive block, but has not revealed any production figures on the wells.

Four wells have been completed and several locations staked. Drilling is done from a permanent 28-well platform built 1.5 miles offshore in 95 ft. of water.

Interest in the parcel is running high. Three companies have applied to drill core holes near where Texaco cored several months ago. Core-hole applications for Standard Oil Co. of California, Gulf Oil Corp., and Pauley Petroleum Co. have been approved. Richfield Oil Corp. and Socal recently completed core holes on the acreage.

The State Lands Commission delayed opening the block at its last hearing to permit the companies more time to core-drill the acreage.

Marketers may skip a spring boost in octanes this year

THIS may be the year of stagnation in octane increases — unless marketing managements decide on a boost in a hurry.

Octanes held steady in May, according to Ethyl Corp.'s nationwide survey. For many years, spring was the traditional time for an octane move to kick off promotion for the motoring season.

But so far this year, nothing has happened.

Marketers have been doing some real soul searching, especially in connection with the big increase in regular octane that occurred last year. And they seem to be resisting whatever pressure there is for a further increase.

It appears there may be no move now until some marketer decides to grab a temporary advantage by raising his octanes.

Last month gasoline on sale at service stations had an average Research Octane Number of 99.3 for premium and 92.6 for regular.

Premium was 0.1 number below a year ago while regular was 0.1 above May 1960.

Average tetraethyl lead contents were 2.33 ml. per gallon for premium and 1.71 ml. for regular.

Regular octane has been on a plateau since last November after increasing 0.6 RON, while premium was up only 0.2 for 1961.

As one knowing observer put it, "the absence of any octane move doesn't rule out the possibility of a definite increase this year, but it certainly makes it less likely."

Minute

These are the men who REDUCE YOUR COSTS

D. M. Lawrence
General Service Mgr.
Pampa, Texas

Raymond Johnson
Pampa,
Texas

Tommy Knoblach
Great Bend,
Kansas

Louis Sears
Odessa,
Texas

Harold Brown
Casper,
Wyoming

Enid Duggins
Houston,
Texas

H. B. Smith
Edmonton,
Canada

Jim Morrow
Seminole,
Oklahoma

Dave Kelley
Anaco,
Venezuela

D. C. Jorden
Tulsa,
Oklahoma

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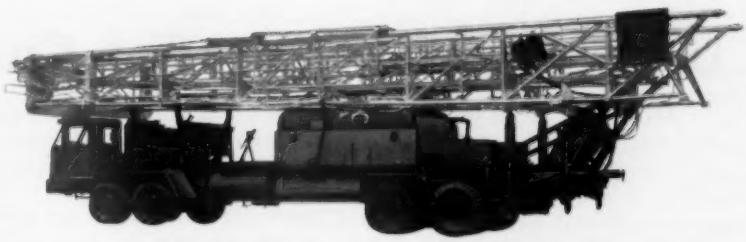


Use First Class Service
for First Class Servicing Units

WELL SERVICING AND DRILLING UNITS
FRANKS
PAMPA, TEXAS
CABOT

CABOT CORPORATION
MACHINERY DIVISION

U. S. absorbs the increase

Canadians Boost Crude and Liquids Output

CANADA is making giant strides toward fulfilling government goals for increasing crude-oil and natural-gas-liquids production.

And the U. S. market thus far is absorbing the entire increase, more than offsetting a decline in Canada's demand for its own crude in the first quarter.

Canadian production for the first 7 months of the year will run about 12% ahead of last year, according to nominations and estimates filed with provincial conservation boards. Exports to the U. S. for the same period will be up about 50%.

Minister of Trade and Commerce George Hees last February directed companies to boost production to 625,000 bbl. daily by midyear and to 640,000 bbl. daily for the full year 1961. The alternative offered them was import controls which would force domestic crude into Montreal. This area is now supplied solely by foreign crude.

The companies also were told how to accomplish the government recommended targets: Step up exports to the U. S. and displace foreign crude and products entering eastern Ontario—west of the Ottawa Valley—with Canadian supplies.

Hees' whip cracking has met with resounding success on the exports to the U. S. These have risen beyond expectations. However, there have been few visible results on the displacing of foreign crude. But changes are due in the second half of the year.

With a firming of the Canadian crude market, it appears that the industry can expect production for the full year to be 615,000 to 620,000 bbl. daily. This is still short of Hees' mark. But an increase of almost 15% from last year's 542,000 bbl. daily would be an accomplishment.

Exports soar . . . Exports to the U. S. have increased every month this year, rising from 129,950 bbl. daily in January to 168,700 in May.

And estimates for the next 2 months are for record levels of 194,700 and 196,500 bbl. daily before a temporary decline in August to 169,635 bbl. daily.

The first 8 months' average of 162,800 bbl. daily will be an increase of 50% over the 108,500 bbl. daily in 1960.

Exports to the Great Lakes area through August will average about 87,500 bbl. daily compared to 62,000 bbl. daily for all of last year. Exports to the Puget Sound area of Washington will be 75,300 bbl. daily, up from 46,500 bbl. daily in 1960.

The flow into Puget Sound will peak this month at 104,000 bbl. daily, some 22,000 above May, the previous high, and only 31,000 bbl. short of regional refining capacity.

The big jump came when Shell Oil Co. raised its take from 13,000 bbl. daily to 31,000 bbl. daily at Anacortes. Mobil Oil Co. raised purchases slightly to 33,500 bbl. daily at Ferndale, and Texaco Inc. continued the 40,000 - bbl. - daily begun in April at Anacortes.

All three will cut back in August—Shell to 24,000, Mobil to 14,000, and Texaco to 35,000—dropping Puget Sound exports to 73,000 bbl. daily.

The new customers this year in the Great Lakes area are holding to importing schedules through the summer. The companies and amounts in barrels daily are: Sohio Petroleum Co. at Toledo, 12,000; Ashland Oil & Refining Co. at Buffalo, 8,000; Gulf Oil Corp. at Toledo, 5,000; and Mobil Oil at Trenton, Mich., 10,000.

With the big export stimulus, western Canada production of crude and natural gas liquids will reach 648,000 bbl. daily in July. The average for the first 7 months is estimated at about 615,000 bbl. daily, some 67,000 bbl. daily above the same period of 1960.

Canadian imports gain . . . Imports

U. S. Market for Canadian Crude to Grow

CANADIAN producers may be exporting 1.6 million barrels daily of crude into the United States by 1980.

This prospect means the finding rate for crude in Canada may have to be doubled.

These opinions were expressed by A. F. Down, president of British Petroleum Co. of Canada, Ltd., in an address before the annual meeting of the western Canada conference on financial management and petroleum accounting held at Banff.

Down estimated demand in the U. S. may reach 17.5 million barrels daily in 1980 rising above a static or even declining domestic output.

"While improvements in secondary recovery and in technology undoubtedly will keep production in the U. S. at a high level, it seems inevitable that a substantial increase in imports can be expected," he said. "It is possible that as much as a third of total U. S. consumption requirements will be met by imports within the next 10 years."

Outlook for Canada . . . Down gave this picture of Canadian production by 1980:

. . . Export to U. S. of 1.6 million barrels daily is quite possible.

. . . Canadian domestic requirements by then are estimated at 1.8 million barrels daily with about one-third of this being supplied by imports into eastern Canada, leaving about 1.2 million barrels daily for domestic producers to supply.

This means a total demand of 2.8 million barrels for Canadian producers.

Down said that to have at least 12 years of reserves in the ground in 1980, the total new reserves to be found would amount to 16 billion barrels—an average finding rate per year of 800 million barrels.

"This is double the Canadian finding rate . . . which has been averaging about 400 million barrels" since the discovery of Leduc. Down

supplied all of Canada's increased crude demand during the first quarter, compilations by the Dominion Bureau of Statistics have revealed.

Crude imports were up 37,500 bbl. daily to 351,600 bbl. daily. Domestic crude consumption at the same time actually fell from 445,000 to 433,700 bbl. daily.

Ontario, the key to boosting Canadian refiners' use of prairie crude, slipped from 222,000 to 211,000 bbl. daily in crude consumption.

But estimates for the second quarter and forecasts for the year indicate a good pickup in domestic demand for Canadian crude. Hees' demand for increased use of Canadian crude in Ontario appears to be bearing fruit.

The statistics bureau estimates a 25,000-bbl.-daily increase for domestic-crude consumption in Ontario for all of 1961. This would boost the year's average to 223,000 bbl. daily.

Ontario would account for most of the 31,300-bbl.-daily increase forecast for domestic-crude consumption. The total forecast of 443,300 bbl. daily would be a 7.5% increase over last year.

Crude imports are expected to rise 8.3% from 344,900 last year.

Total demand is not due to increase at the rate of crude demand. And so the forecast apparently assumes a decrease in products imports in eastern Canada—another government goal.

told the members of the conference. He added that his predictions indicate the present ratio of reserves to production of 25 years in Canada is only a short-term situation and can change rapidly.

Problems . . . The obvious markets for Canadian crude still will be the Puget Sound area and the northern Mid-Continent, Down said.

The Puget Sound area has been the most popular because it displaces offshore oil, Down reported. But competitive pressures in this area have grown recently and will continue with the increase of Alaskan oil coming into the picture.

Anadarko Gas Line Charted

- Fish Engineering, Pan Am map preliminary work on big transmission line from Oklahoma to St. Louis area.

FIRST STEPS have been taken in a plan to build a 550-mile natural-gas pipeline from Northwest Oklahoma to St. Louis and an industrial area of western Illinois.

Ray C. Fish, board chairman of Fish Engineering Corp., said the Oklahoma Illinois Gas Pipeline Co. had been chartered in Delaware to carry out the project.

Pan American Petroleum Corp., which holds leases on 1.6 million acres in Oklahoma's Anadarko basin, is joining with Fish in development of the pipeline plan.

Fish said engineering and design work is under way, but he could not estimate when construction would begin.

Actually, Fish said, the plan is still in the preliminary stage. Several alternative plans are under consideration.

However, an application will be filed with the Federal Power Commission for approval of the large-diameter line when preliminary work is farther along.

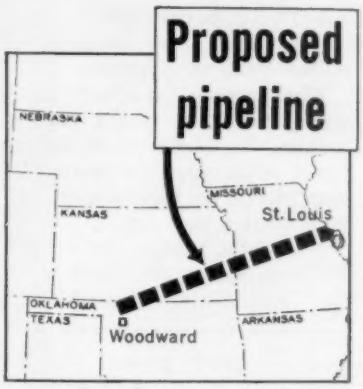
Fish said the St. Louis area has a remarkable record of growth. This, coupled with its great potential, "makes it a natural market for new supplies of natural gas," he added.

The proposed line would start near Woodward, Okla., run across northern Oklahoma, cut through southeastern Kansas, and continue diagonally across Missouri to St. Louis. It would cross the Mississippi River to take gas into western Illinois.

Pan Am's role . . . Pan Am, the exploration-production affiliate of Standard Oil Co. (Indiana), would be going into the natural-gas transmission business for the first time.

Last year the company drilled or participated in 86 wells in the Anadarko basin, which is becoming a major gas reserve.

Several companies are taking gas from the sprawling basin at present. Among them are Transwestern Pipeline Co., Michigan Wisconsin Pipe Line Co., Cities Service Pipe Line Co., and Oklahoma Natural Gas Co.



The St. Louis area is served by only one natural-gas pipeline. This is a Mississippi River Fuel Corp. line that carries gas from Louisiana.

Texas Orders Natural Gas Pipeline Co. to Buy Gas Ratably

THE Texas Railroad Commission has ordered Natural Gas Pipeline Co. of America to follow schedule allowables in taking gas ratably from Boonsville Bend conglomerate gas field in Wise County.

The order was issued after a hearing on a complaint by McCommons Oil Co., Dallas, which charged that Natural was not taking gas in accordance with commission allowables.

The commission overruled Natural's arguments that its gas takes from McCommons and other producers in the field were in agreement with signed contracts based on reserves as required by the Federal Power Commission.

The order says that if Natural cannot conform to allowables because of demand fluctuation, the company should share demand between all its connections proportionately.

A common purchaser of gas, the commission said, must purchase without discrimination between producers in the same field.

Southwestern Refinery Runs Shaved Again

• April runs in five-state area drop 1.9% from previous month, which saw an even greater cutback of 4%. But April figure is higher than year ago.

SOUTHWESTERN refiners trimmed runs during April for the second consecutive month.

Plants operated at a daily average throughput of 3,313,571 bbl., accounting for 42.5% of the national figure. Area runs were down 1.9% from March, but they were up 1.3% over April a year ago.

Nationally, refiners cut runs below both March and April a year ago. Daily average runs of 7,802,000 bbl. for April were down 239,000 bbl., or 1.5% from March, and were down 2% from April 1960.

All southwestern states showed a decline in runs during April except Oklahoma. It remained the same at about 322,600 bbl. At the same time two states, Arkansas and Mississippi, showed a decrease from runs a year ago.

On a capacity comparison, southwestern refiners operated their plants closer to top ratings. The five-state area operated at 87% of capacity, the highest for a big-volume area. The East Coast was the lowest at 74%.

Capacity comparisons for other parts of the country show the Gulf Coast at 86%, Mid-Continent at 79%, Rocky Mountains at 70%, and the West Coast at 86%.

Nationally, runs averaged about 79.4% of calendar-day capacity.

ARKANSAS

(Refinery Runs in Barrels Daily)

Company and location—	April	March	April 1960
American, El Dorado	25,606	39,744	33,087
Lion, El Dorado	34,557	34,132	33,539
MacMillan, Norphlet	2,643	2,557	2,129
Other	6,569	6,001	5,778
Total Arkansas	69,375	82,434	74,533

LOUISIANA

Cities Service, Lake Charles	165,006	165,028	170,057
Continental, Lake Charles	50,059	51,693	54,884
Humble, Baton Rouge	301,566	293,761	293,733
Ingram, Meraux	19,212	19,427	16,712
Shell, Norco	105,716	97,986	106,515
Tenneco, Chalmette	22,601	44,833	18,974
Other	7,422	8,116	8,329
Total Louisiana	671,582	680,844	669,204

MISSISSIPPI

Paluxy, Yazoo City	1,344	1,294	1,282
Pontiac, Hattiesburg	15,744	16,150	16,279
Southland, Sandersville	3,876	4,655	4,163
Total Mississippi	20,964	22,099	21,724

OKLAHOMA

Allied, Stroud	2,734	1,736	2,782
Anderson-Prich., Cyril	10,144	10,256	8,856
Bell, Grandfield	6,236	6,474	6,689
Ben Franklin, Ardmore	11,169	10,947	10,738
Champlin, Enid	29,437	29,456	27,599
Cities Service, Ponca City	29,673	31,508	29,465
Continental, Ponca City	59,463	59,463	67,148
DX Sunray:			
Duncan	37,976	39,394	40,314
Tulsa	72,419	70,012	57,718
Kerr-McGee:			
Cushing	18,015	18,271	23,390
Wynnewood	18,218	17,912	21,373
Midland Co-op., Cushing	12,053	12,074	5,015
Phillips, Okmulgee	15,075	15,106	17,007
Texaco, Tulsa	*	*	*
Total Oklahoma	322,612	322,609	318,094

*Not reported to Oklahoma Corporation Commission.

TEXAS

(Refinery Runs in Barrels Daily)

Company and location—	April	March	April 1960
American, Texas City	143,066	117,755	103,420
Am. Petrofina:			
Mount Pleasant	16,242	17,099	13,178
Wichita Falls	6,098	4,894	7,612
Atlantic, Port Arthur	64,573	62,346	65,111
Col-Tex, Colorado City	7,502	7,560	4,948
Continental, Wichita Falls	9,357	11,099	11,371
Cosden, Big Spring	28,995	28,522	28,541
Crown Cent., Houston	31,411	34,549	34,029
Delhi-Taylor:			
Corpus Christi	34,793	40,339	32,739
Port Isabel	1,968	5,750	3,394
Eddy, Houston	2,063	2,101	2,162
El Paso, Odessa	14,322	12,669	13,099
Gulf, Port Arthur	246,203	254,802	274,244
Howell, San Antonio	2,616	1,994	2,157
Humble, Baytown	290,261	282,500	242,697
La Gloria, Tyler	17,360	16,399	15,729
Mobil, Beaumont	203,667	205,855	175,968
Phillips:			
Phillips	69,063	70,470	62,067
Sweeny	50,023	58,848	68,486
Plymouth, Texas City	35,366	35,377	25,960
Pontiac, Corpus Christi	51,359	51,461	37,732
Premier:			
Fort Worth	7,776	7,798	7,733
Longview	3,146	3,110	4,568
Pure, Nederland	78,175	83,253	80,124
Shamrock, Sunray	17,423	23,329	23,615
Shell, Houston	100,510	104,733	119,946
Signal, Houston	53,779	*53,202	45,831
Sinclair:			
Corpus Christi	20,511	22,220	29,024
Houston	126,730	124,653	132,146
Skelly, Longview	3,120	1,545	3,006
Southwestern, Corpus Christi	34,251	30,799	38,148
Stand. Tex., El Paso	49,753	52,253	50,748
Suntide, Corpus Christi	33,896	40,768	32,522
Texaco:			
Amarillo	15,619	17,118	9,459
El Paso	11,367	8,445	2,526
Port Arthur	*256,966	*267,581	*288,830
Port Neches	27,465	44,291	41,699
Texas City, Texas City	33,924	32,100	28,324
Other	28,319	28,888	24,199
Total Texas	2,229,038	2,268,475	2,187,092

*Includes condensate.

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Continental's D+B pump shops are manned by trained, field experienced specialists using modern equipment and methods. The result: *superior service.*

Precision micrometers, gauges and special test equipment are used to check OD of plungers . . ID of liners and tubes . . pressure-test pumps after assembly. Specially designed aligning mandrels and clamps are used to accurately assemble and repair sectional liner pumps and composite plungers. Special vises prevent distortion of tubes and plungers. The use of friction tongs eliminates pipe wrench marks . . open doors for corrosive fluids. Vacuum testers are used to test fluid seal of valves. Desanding equipment is used to remove frozen plungers and entire pumps from sanded joints often saving considerable money by salvaging parts. Cooking vats and steam cleaning equipment remove paraffin and other deposits and also eliminate corrosive effects of salt water during pump repair. Each shop has special equipment to handle the popular pumps of the area.

Continental's training program keeps personnel "up" on all types of pumps, improved methods of assembly and new materials. You always get a longer pumping run for your dollar at D+B pump shops.

CONTINENTAL-EMSCO D+B PUMP SHOPS

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ALBERTA
Calgary
Drayton Valley
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SASKATCHEWAN
Estevan

VENEZUELA

Anaco
Las Morochas

UNITED STATES

ARKANSAS
El Dorado
Magnolia

CALIFORNIA
COASTAL REGION
Ventura

LOS ANGELES BASIN
Long Beach
Santa Fe Springs

SAN JOAQUIN VALLEY
Oildale
Taft

KANSAS
El Dorado
Ellinwood
Liberal
Pratt
Russell

LOUISIANA
NORTH LOUISIANA
Jena
Shreveport

SOUTH LOUISIANA
Lafayette
Lake Charles

MISSISSIPPI
Laurel
Natchez

OKLAHOMA
County Line
Drumright
Duncan
Healdton
Lindsay
Oklahoma City
Perry
Seminole

TEXAS
EAST TEXAS
Kilgore
Palestine
Winnsboro

NORTH AND WEST CENTRAL TEXAS
Abilene
Graham
Nocona
Wichita Falls

SOUTH TEXAS
Alice
Freer
McAllen
Corpus Christi

SOUTHWEST TEXAS
San Angelo

TEXAS GULF COAST
Daisetta
El Campo
Houston
Luling
Victoria

TEXAS PANHANDLE
Borger
Pampa

WEST TEXAS
Andrews
Forsan
Hadacol Corners
McCamey
Monahans
Odessa
Post
Snyder
Sundown
Kermit

Rocky Mountain States

COLORADO
Rangely
Sterling

MONTANA
Cut Bank
Glendive

NEBRASKA
Kimball

NEW MEXICO
Farmington
Hobbs
Tatum

NORTH DAKOTA
Williston

WYOMING
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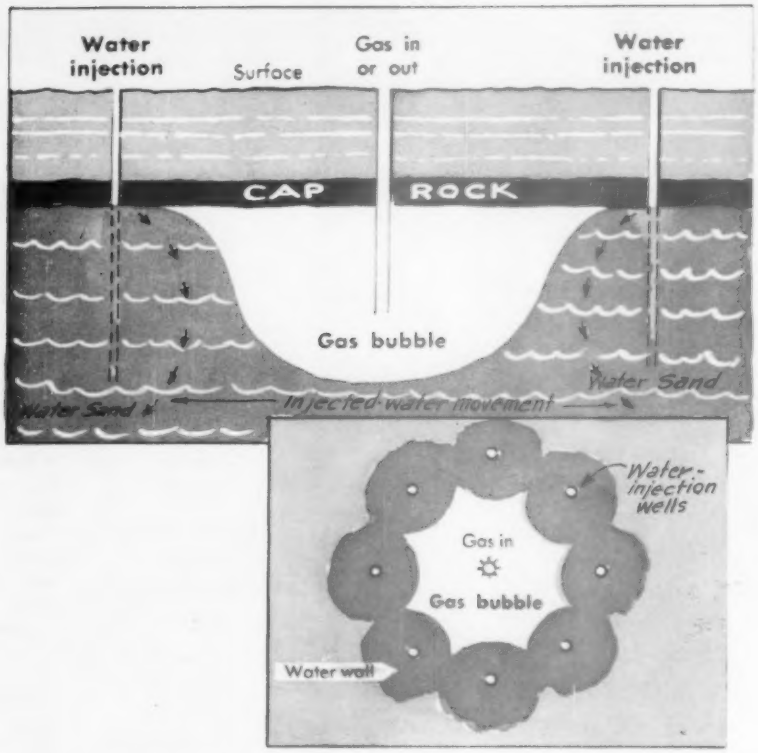


"Bubble" Storage Test Delayed

• Difficulty in injecting water is holding up Northern Illinois' project to see whether gas can be stored under a flat cap rock and kept in place with a wall of water.

IT WILL be a while before the industry learns whether Northern Illinois Gas Co. has come up with a valuable new method of storing natural gas underground.

Its unique project to store gas in a porous sandstone under a flat cap rock and keep it there by a surrounding wall of water is temporarily stymied.

The sand won't take the injection water as rapidly as calculations indicated it should.

In a preliminary report last week to the Interstate Oil Compact Commission, H. E. Schwalm of Northern said the company hopes to solve the injection problem quickly and have some preliminary reports this fall on the operation of the storage technique.

The project first got under way about this time last year (OGJ, June 13, 1960, p. 76).

The project . . . Northern Illinois is testing a theory that a wall of water can control a volume of gas, keeping it collected in one mass under a flat cap rock.

The company has no plans for storage exactly like this, but it hopes to prove that, given a three-sided structure, it can use a wall of water to seal off the open side.

The project is of great importance to Northern Illinois because of two things: The steady increase in the company's peak-day deliveries, and the lack of conventional storage facilities in the Chicago area.

The pilot project is only 34 miles southwest of the Chicago loop.

The company drilled a test to 1,132 ft. It found a good cap rock in the Trenton sand at 640-980 ft. and, under it, a good storage sand in the St. Peter. The upper 25 ft. of the St. Peter has an average porosity of 19.8% and a permeability of 885 md.

It offered a good test of the technique because there is a change of elevation of only 9 ft. across the 1,700-ft. diameter of the pilot project.

Northern Illinois drilled 13 more wells—8 for water injection, 1 for gas, and 4 for observation.

Schwalm told the Compact's research committee that if the company can—by changing injection rates—move the gas bubble back and forth across an observation well, it will consider the experiment a success.

The problem . . . The operators hope to inject water at the rate of 25 gal. per minute per well, or a total of 200 gal. per minute. This would allow for a bubble growth at the rate of 800,000 cu. ft. daily.

But they have found that the St. Peter sand does not take water as fast as calculations indicated.

The original trouble was that water from the shallower Silurian formation contains iron and when this was mixed with the St. Peter water, which contains sulfur compounds, a black precipitate formed and plugged the downhole filters.

An iron-removal plant was installed for the Silurian water. But even though the wells have been cleaned and there is no precipitate forming at present, the sand does not take water at the required rate.

PROCESSING

A new butadiene extraction unit will be built for Polymer Corp., Ltd., by Fluor Corp. of Canada at Sarnia, Ontario. Construction on the $1.5 million unit, using Shell's acetonitrile extractive distillation process, is scheduled to begin this month. Completion expected late this fall.

Gas-processing facilities of Ohio Oil Co.'s plant near Mosherville, Mich., will be expanded about 50% from the present capacity of 25,000 M.c.f.d. Completion is expected by early fall.

Atlantic Refining Co. and Hydrocarbon Research, Inc. have joined forces with Esso Research & Engineering Co. in licensing the thermal hydrodealkylation process (HDA) developed by the first two compa-

Underground Capacity at New High, AGA Says

CAPACITY of underground storage areas across the United States which hold natural gas in reserve for peak winter months has reached record heights.

The American Gas Association reports this capacity at the start of the year at 2.9 trillion cubic feet compared with 2.5 trillion at the start of 1960. The previous peak was 2.7 trillion cubic feet at the start of 1959.

These highlights of the annual AGA survey were announced at AGA's Transmission Conference in Denver by R. W. Todd, vice president for operations of Pacific Lighting Gas Co., Los Angeles. He is chairman of the underground gas storage statistics subcommittee.

The storage areas in 20 states are mostly depleted oil and gas fields. They serve as giant "banks" from which gas can be withdrawn during cold weather when consumer demands exceed pipeline capacity.

Todd noted that California particularly has made great advances in gas-storage building, nearly tripling its capacity in a year. California began 1960 with 99 billion cubic feet capacity and ended the year with 271 billion. It now supplants Oklahoma as the state with the fifth largest underground storage capacity.

The AGA reported that during the year eight new storage pools were put into operation, making a total of 217; and total active wells increased by 475 to 7,811.

The Oil and Gas Journal's annual natural-gas underground storage survey reported that when planned facilities are completed this year the nation's storage capacity will exceed 3.19 trillion cubic feet (OGJ, May 8, p. 83).

The Journal's survey revealed that total storage capacity either now existing, started, or testing was 3.05 trillion cubic feet.

States with Underground Gas Storage

State—	Total Reservoir Capacity (M.c.f.) 12-31-60	Total Reservoir Capacity (M.c.f.) 12-31-59	Total Gas In Storage Reservoirs (M.c.f.) 12-31-60	Total Gas In Storage Reservoirs (M.c.f. 12-31-59
Arkansas	5,204,421	5,204,421	5,042,026	4,831,380
California	270,920,132	99,038,182	121,893,310	64,875,494
Colorado	3,000,000	186,700	728,592	164,482
Illinois	104,992,153	45,915,003	52,600,820	46,133,579
Indiana	15,164,036	12,453,884	11,944,771	10,353,439
Iowa	65,534,074	49,893,534	65,534,074	46,071,983
Kansas	101,514,193	83,623,223	82,567,719	70,834,376
Kentucky	24,684,091	27,264,569	26,110,810	27,197,228
Michigan	464,876,424	397,498,020	341,315,633	281,454,218
Mississippi	6,701,795	7,056,540	5,465,174	6,008,696
Missouri	11,238,774	9,716,585	11,239,446	9,602,563
Montana	96,452,193	87,075,505	55,183,327	42,965,415
New Mexico	77,871,510	77,871,510	44,423,777	47,873,736
New York	65,519,261	65,231,688	59,222,409	57,559,840
Ohio	437,392,393	433,515,740	349,315,134	336,764,348
Oklahoma	175,533,723	179,977,245	118,899,739	117,780,031
Pennsylvania	476,927,507	496,848,519	454,598,685	407,290,892
Texas	59,975,056	50,686,975	61,051,332	49,862,121
West Virginia	343,036,152	328,523,941	295,294,851	258,470,969
Wyoming	62,971,841	62,971,840	21,572,219	20,424,205
Total	2,869,509,730	2,520,553,624	2,184,003,848	1,906,518,995

BRIEFS . . .

nies. Techniques and know-how resulting from the development work of all three companies will not be offered in HDA license. The process can be applied to produce benzene from toluene and xylene feed stocks, or to produce naphthalene and benzene from stocks such as light catalytic cracking cycle oil (OGJ, Mar. 6, p. 80).

A gas liquids extraction plant with a capacity of 650,000 M.c.f.d. will be built near Yscloskey, La., about 30 miles southeast of New Orleans. It will be owned by Shell, Calco, Cities Service, Humble, Continental, Atlantic, and Tidewater. Shell will be operator. Daily liquids production of 10,000 bbl. will be separated by Union Texas Natural Gas Corp.'s Toca, La., plant about 10 miles west of Yscloskey. Construction should start August 1. Completion is expected about May 1, 1962.

An ethane recovery unit is under construction at Shell's Sheridan, Tex., plant for processing ethane-rich streams from both the Sheridan and Provident City plants. On completion in October, the ethane will be sent to Dow's Freeport plant through a pipeline that is presently carrying only propane. Fish Engineering Corp. is handling the construction.

A combination crude distillation, vacuum, and visbreaker unit with capacity of 60,000 bbl. daily is being built at Signal's Houston refinery. The new unit will replace outmoded facilities. Brown & Root is contractor. The unit is expected to be completed late this year.

A small refrigeration plant will be built in Texas County, Oklahoma, by Republic Natural Gas Co. Construction on the plant for extracting natural gasoline and heavier hydrocarbons will begin in late summer.

A crude-oil distillation unit with a 37,000-bbl. daily capacity is under construction at American Oil Co.'s Casper, Wyo., refinery. The new facilities will replace two batteries of obsolete stills. The unit is expected to be ready for operation by September 1.

Automobile antismog devices must reduce exhaust emissions of hydrocarbons to 275 p.p.m. and carbon monoxide to 1.5% according to limits set by the California State Motor Vehicle Pollution Control Board. The board also specified various driving conditions over 20-minute test periods.

Merger Creates Giant New Pipeline Company

• Consolidation of Humble Pipe Line and Interstate forms 12,500-mile network of crude, product, and LPG lines. Only Service Pipe Line has more.

JERSEY STANDARD'S two big domestic pipeline organizations—Humble Pipe Line Co. and Interstate Oil Pipe Line Co.—will be merged into a single affiliate of Humble Oil & Refining Co.

The move is another step toward gathering all of Jersey's domestic operations under the Humble tent at Houston.

Interstate's president, Phelan H. Hunter, will move to Houston from Shreveport to take over the presidency of the new company—as yet unnamed—and Humble Pipe Line's president, W. S. Spangler, will be the executive vice president. Both will be directors.

When the new Humble Oil & Refining Co. was organized late in 1959, the old Humble's pipeline subsidiary became a subsidiary of the new organization. Interstate continued as a Jersey subsidiary.

The new pipeline company will amalgamate 9,500 miles of crude, product, and liquefied - petroleum - gas lines of Humble Pipe Line with 3,000 miles of crude and product lines of Interstate.

The resulting total — 12,500 miles—will still be less than the 14,925 miles of line operated by Service Pipe Line Co., Tulsa, subsidiary of Standard Oil Co. (Ind.). Service has the greatest mileage of any company operating mainly crude lines.

Humble Pipe Line operates wholly in Texas. Its 5,800 miles of trunkline and 3,600-plus miles of gathering lines serve 668 oil fields and have a crude throughput of 700,000 bbl. daily.

In the last 2½ years the 42-year-old company has undergone a reorganization to simplify its operations (OGJ, Mar. 20, p. 197). Just how the new merger will affect these changes is not yet known. The company has 1,300 employes.

Interstate, 10 years older than Humble Pipe Line, operates nearly 2,000 miles of trunkline and more than 950 miles of gathering lines in Louisiana, Mississippi, Illinois, and Montana.

Interstate serves more than 8,000 wells in 260 producing areas and has more than 470,000 bbl. daily of throughput. It has 650 employes.

The size of the merger, in terms of dollars, was not disclosed. However, the Interstate Commerce Commission once evaluated Humble Pipe Line's assets at $132 million. This would indicate a merger involving properties valued at more than $200 million.

Interstate currently is taking a leading role in construction of the West Shore products line between Milwaukee and Green Bay, Wis. Ten firms have an interest in the line.

Hunter has been elected president of West Shore Pipeline Co. Construction starts this month (OGJ, April 10, p. 70).

The announcement of the Humble-Interstate merger plans last week did not disclose details of the new company except that its stock would be owned by Humble Oil.

Since headquarters will be in Houston, it is anticipated that a large number of Interstate's home office employes will be affected.

Shell Pushes Efficiency Campaign

A DRIVE to improve over-all efficiency in Shell Oil Co. is causing personnel cuts in several departments. But Shell is adding to the work forces in some other cases.

"Each department has been asked to look over its own operations and make sure they are conducted in the most efficient manner," a company spokesman says.

The campaign in the Marketing Department is taking the form of consolidation of division offices in Albany, Indianapolis, and Minneapolis with other offices. These changes involve only administrative and service functions now performed by separate divisions.

Shell expects to achieve further economies when data-processing centers are completed in Tulsa and in Menlo Park, Calif., to handle paper work.

The belt tightening comes in the wake of a disappointing year for Shell.

Net income last year was down $3 million to $145 million, Monroe E. Spaght, president of Shell, noted in an annual report to employes. Earnings for the industry generally were up about 7%.

Spaght commented on his company's and the industry's cost-price squeeze and urged employes to rise to the challenge of a tougher competitive situation.

Shell's position can be maintained, he said, only if it is at least as efficient as its severest competitor.

"Shell is a sound, growing company," Spaght emphasized, "but there are clear demands on each of us if it is to remain so."

One of these, he said, is avoidance of waste.

"Waste, it seems to me, is the failure to make proper use of our time, energy, skill, knowledge, materials, and equipment—and prob-

PIPELINE

Los Angeles residential areas soon will be crossed by two pipelines—a 6-in. oil line and an 8-in. gas line. The lines will link Las Cienegas field in La Brea-Crenshaw area with trunk lines. Union Oil and Signal Oil & Gas, co-discoverers of Las Cienegas field, are the builders.

Delivery of pipe for a 500-mile 12-in. crude line from Fort St. John to Kamloops, B. C., will begin this month. Canadian Bechtel will build the northern section and Dutton Williams the central and southern sections. The $30-million line will have a capacity of 75,000 bbl. daily.

Bluitt field in Roosevelt County, New Mexico, will be connected to Transwestern Pipeline's system by

ably the most serious of these is waste of time."

Another concern, he said, is to banish inertia—the disinclination to move or act, which Spaght described as a collateral product of prosperity.

Supreme Court gives states jurisdiction in Kansas pricing case

THE U. S. Supreme Court has ruled that a pipeline company which was forced to pay higher prices under a Kansas minimum-price law may sue in state courts to try to recover "overpayments."

Producers involved had argued that the Federal Power Commission, not the state courts, had jurisdiction.

The problem arose in this fashion:

Kansas ordered, effective January 1, 1954, that a minimum of 11 cents per M.c.f. must be paid for gas taken from the Hugoton field in Kansas.

Cities Service Gas Co. was purchasing gas under contract for 8 cents. It began paying 11 cents, but notified producers that it was doing so under protest and that if the Kansas law were found to be illegal, it would seek a refund from producers.

Later that year, after the Supreme Court had ruled in the historic Phillips case that FPC had jurisdiction over producer prices, the producers filed an 11-cent rate with FPC.

Meanwhile, a challenge of the Kansas law went to the courts. Four years later, the Supreme Court ruled the Kansas minimum-price order was illegal.

Cities Service, a Delaware-based pipeline company, then sued in the Superior Court of that state for refund payments from Pan American Petroleum Corp., Texaco Inc., and Columbian Fuel Corp.

The legal question that then developed was over jurisdiction.

The Supreme Court ruling last week settled that. It emphasized that this was the sole point at issue and that it was not ruling on whether Cities Service was entitled to a refund.

It is expected that similar suits will now be filed in courts in other states.

Miscible Drive Planned for Yates Field

ATLANTIC Refining Co. this summer will kick off a miscible drive in a watered-out Yates sand reservoir where it had its greatest water-flood success.

It will start off the tertiary-recovery project as a pilot test on its prolific W. D. Johnson lease in South Ward field of Ward County, West Texas. The pilot will be extended over the lease when test results warrant.

Plans call for injecting a slug of propane, then gas, then a mixture of gas and water.

Atlantic engineers feel the project will recover about two-thirds of all oil remaining in the reservoir, leaving residual oil saturation at only 8.8% of pore space at abandonment.

Estimated oil added by the project, they feel, should run between 5,000 and 10,000 bbl. per acre. Extended over the entire 320-acre lease, this would mean a total added take of between 1,600,000 and 3,200,000 bbl.

This would be added to past recoveries of 1,556,375 bbl. by primary operations and a phenomenal 4,152,968 bbl. from the water flood.

Up to the first of April, Atlantic had injected a startling 22,500,000 bbl. of water into the Yates during the 11-year-old flood. The lease, discovered in 1933, now is producing 97% water.

BRIEFS . . .

48 miles of small-diameter line if certain conditions are met. FPC has authorized the project if an initial price of 16 cents per M.c.f. is accepted and an upward B.t.u. adjustment clause is eliminated.

Construction of 80 miles of products line for SunOlin Chemical has been started by Sheehan Pipe Line Construction. Fifty miles of 6-in. line and 30 miles of 4-in. line will run from Paulsboro to Deepwater, N. J.

Contract to build 13.4 miles of 26-in. line from near Port Acres, Jefferson County, to near Bridge City, Orange County, Texas, has been awarded to Grayco Constructors by Humble Oil & Refining. Construction begins this month.

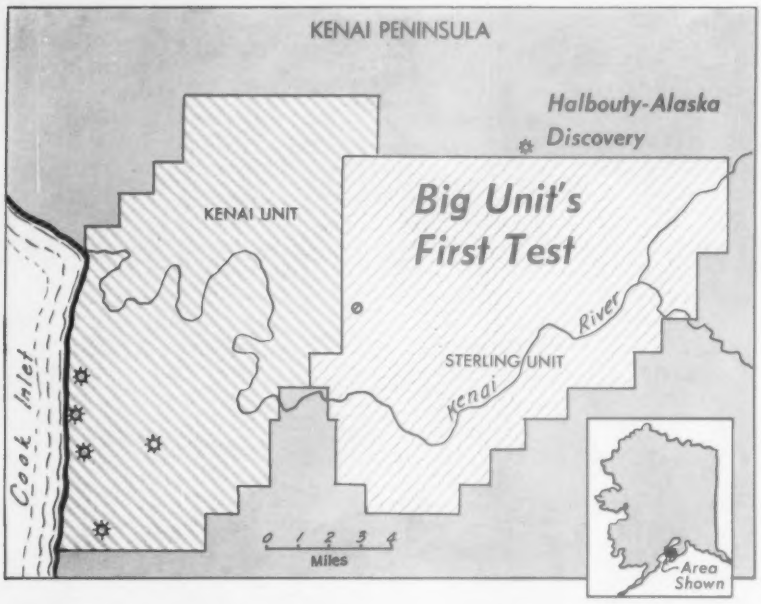
FPC has granted temporary authorization for Transcontinental Gas Pipe Line to lay 37 miles of small-diameter lines to take gas from the Ship Shoal and South Pelto areas of offshore Louisiana.

A 14.53-mile 8-in. gas line which Lone Star Gas is building from a point 15 miles west of Ardmore, Okla., to Pure Oil's plant near Glenn, Okla., will be completed this month. The $260,000 project will add 10,000 M.c.f.d. to Lone Star's system.

Temporary authorization to build 77 miles of 26-in. line and 24 miles of 18-in. loops in Louisiana has been granted to Trunkline Gas by the FPC. The project also includes 24,000 hp. in added compressor capacity at eight stations. The $18-million project will enable Trunkline to increase deliveries by 54,141 M.c.f.d.

Also for Refiners . . .

IN THE NEWS: State regulatory officials begin push in Senate for tighter natural-gas regulations (p. 36) . . . Texas legislature winds up regular session without passing gas-production tax, but the issue may be revived in a special session (p. 39) . . . American gas experts will get sweeping look at Soviet's growing gas industry in July tour (p. 40) . . . Preliminary moves for gas-transmission line from Oklahoma to St. Louis have been made by Pan American Petroleum Corp. and Fish Engineering (p. 45) . . . Nation's capacity for underground gas storage reaches new high, AGA report shows (p. 49).



Alaskan Unit Gets First Test

- **Wildcatting also will be stepped up as result of two new development contracts and recent lease sale.**

THE FIRST test of the big Sterling unit on Alaska's Kenai Peninsula is drilling below 9,500 ft. toward a target depth in the Hemlock zone that produces the state's only oil.

Union Oil Co., unit operator, plans to take the Sterling unit 23-15 to about 14,000 ft. Location is Sec. 15-5n-10w.

The wildcat is about midway between gas production in the adjoining Kenai unit and Halbouty Alaska Oil Co.'s gas discovery just north of the unit. The Halbouty well is about 45 miles to the northeast and the Kenai wells about 45 miles to the southwest.

Union and Ohio Oil Co. own 87.5% interest in the 63,618-acre unit. Minority owners are Halbouty, Standard Oil Co. of California, Richfield Oil Corp., and Sunray Mid-Continent Oil Co. The same group owns the Kenai unit with Union and Ohio the majority owners. The Kenai unit covers 66,578 acres, giving the group 130,196 acres in the two units.

Five gas wells have been completed on the Kenai unit, but drilling was curtailed due to a lack of a market. Union's management has estimated gas reserves in the unit at between 3 to 5 trillion cubic feet. Production from both the Kenai wells and Halbouty's wildcat comes from sands ranging from 4,000 to 6,000 ft. deep.

The Hemlock sands which are the aim of the Sterling unit well are the pay zone of Swanson River field, the big crude producer about 70 miles to the north.

Development contracts . . . Two more development contracts which will result in new wildcatting have been approved by the Interior Department.

Both contracts are 5-year agreements which carry drilling commitments.

Standard of California was granted a contract covering 247,000 acres in the St. Elias area east of Icy Bay along the southern coast of Alaska. The acreage is in the general area where Phillips Petroleum Co. did some drilling in the early 1950's, but is not part of the Phillips concession.

The company reportedly plans to drill a wildcat in Sec. 4-22s-25e this summer.

The Socal acreage is in between two active wildcat areas. To the west in Sec. 24-20s-15e, Richfield is drilling its second well in the Yakataga area. To the east in Sec. 17-27s-35e, Colorado Oil & Gas Corp. has staked location for the first of several core holes it will drill in the Yakutat area.

Pan American Petroleum Corp.'s new contract covers 586,000 acres in the Baird Inlet area of the Bethel basin.

This acreage is immediately west of the area where Pan American is drilling its Napatuk Creek 1, which is Alaska's most important wildcat. The test has passed its original target of 10,000 ft. (OGJ, May 29, p. 209).

Lease sale . . . Additional drilling also will result from a lease sale held late last month in Anchorage. The sale covered tracts in the old Tyonek bombing range on the north side of Cook Inlet.

Superior Oil Co. was top bidder at the sale, paying bonuses totaling almost $4 million.

Union and Ohio were high bidders on 17 of the 640-acre tracts, including 10 adjoining tracts.

Last month's competitive leasing was the first of two rounds of leasing in this area. Lots will be drawn July 25 on 82 tracts covering 197,209 acres west of the competitive lease area (OGJ, May 8, p. 66).

Ignition device for extinguished gas flares sought

PRODUCERS in Alberta's sour-gas fields are trying hard to find a cheap and reliable method of lighting extinguished flares through automatic ignition.

They need such a device in a campaign to hold down the threat of air pollution from hydrogen sulfide.

Regulations of the Alberta Oil and Gas Conservation Board call for special precautions at wells and batteries where hydrogen-sulfide content of the gas exceeds 5% or whatever figure the board decides should apply.

It is likely that some type of wind-guard may be required for the flares. But this leaves the problem of flares going out when wells on intermittent production are shut down automatically and not relighting when production resumes.

Venezuela Readies New Tax Squeeze on Oil

• Plan would slap levy on profits that exceed 15% return on investment, but overburdened industry isn't up to that level. Last year, return was 11%.

VENEZUELA is apparently ready to levy a new "ghost" tax on oil-industry profits that do not exist.

If the proposed tax measure is passed by Venezuela's Chamber of Deputies, it will put just one more hurdle in the path of the country's already tax-burdened oil industry.

Ironically the tax is being proposed—by Accion Democratica, the country's leading political party—as one answer to the country's dire economic straits.

The present economic condition of Venezuela is the result, at least in part, of stringent belt-tightening by the oil industry. The industry felt compelled to make capital and work cutbacks because of earlier tax measures and government policies which made the future look pretty bleak.

On the surface the proposed new excess profits tax appears to be a minor or perhaps even major revolt against Romulo Betancourt who is titular head of Accion Democratica and has already set an alltime record of more than 2 years as an elected president of Venezuela.

Betancourt, promoting his own program of austerity in government, has said repeatedly that the oil industry has been taxed enough.

Less than a week ago President Betancourt told a Zulia audience it is not "reasonable" to impose new taxes on oil companies. He said oil taxes have reached the "limit."

In spite of the public statements by the president, his own party revealed last week that it has approved in principle a new tax on excess profits earned by oil and mining companies in Venezuela. Just what is meant by "excess" has not been spelled out.

Dr. Jesus Angel Paz Galarraga, secretary-general of AD, said last week in Caracas that the base for such a tax and methods of computing it have not been decided.

The AD secretary-general did say his party has decided that no such tax should be applied on profits unless they exceed a 15% return on investment. If such a tax became law it would almost certainly have the backing of the Copei, or Social Christian Party, the other partner in Venezuela's coalition government.

Dr. Godofredo Gonzales, Copei speaker in the chamber, has made no secret of his party's desire to apply a "greater tax on petroleum companies."

The only qualification by Dr. Gonzales is that his party does not want the additional tax if it would "impair the petroleum economy."

If the tax measure does place a base of 15% return on profits, it would not apply to the present level of oil-company profits. President Betancourt has crowed gleefully in numerous public speaking engagements that the oil industry last year earned only 11% on its investment compared to estimates as high as 33% during the dictatorial regime which preceded the new democracy.

It would serve as a definite ceiling and a curb to the industry in efforts to better its profit picture.

The new tax measure suggested by the finance commission of the Chamber of Deputies apparently means that President Betancourt's austerity program is in for some tough sledding.

The president wants to reduce government salaries and cut back public payrolls sharply to aid the sagging economy of the country.

Betancourt is now stumping the country trying to convince the Venezuelans austerity is essential.

Cordially and Revolutionarily . . .

YOU can never be sure what's going to arrive in the morning mail. This letter, for example, was bundled up in last week's collection of subscription orders, bills, and press releases. The two refineries mentioned are those owned by Shell and Standard of New Jersey.

Cuban Petroleum Institute
Ñico López Refinery
Regla, Havana

Editor
The Oil and Gas Journal

Dear Sir:

It is our duty to inform you that our glorious revolution in behalf of its sacrificed martyrs has won the right for all Cubans to nationalize for the good of Cuba all the petroleum companies.

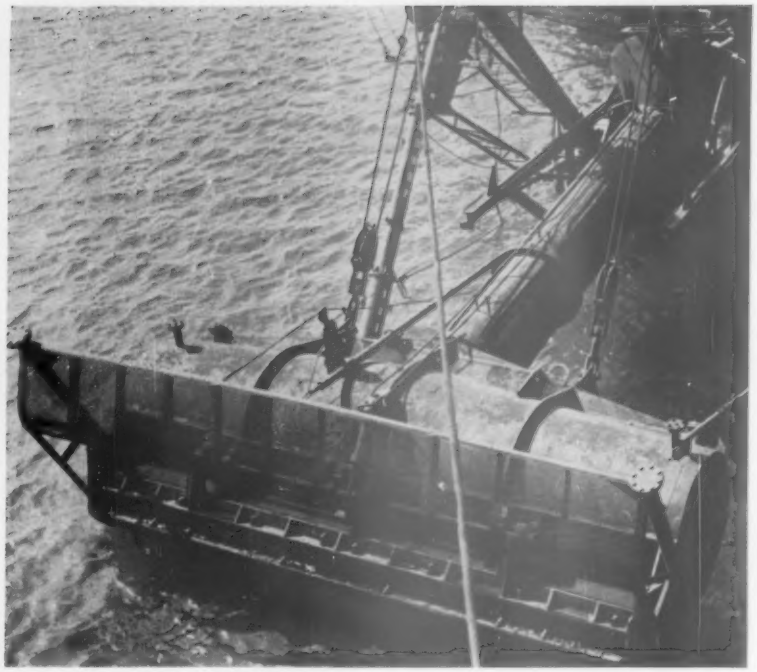
As a tribute to one of our many martyrs, the two refineries located at Regla have been consolidated into one under the name Ñico López refinery, and the new postal address is:

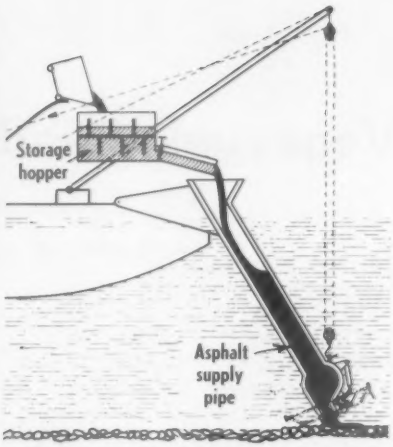
Ñico López Refinery
P. O. Box 1169
Havana, Cuba

Telephones: 90-1011 to 90-1019

I remain cordially and revolutionarily yours,

"The Homeland or Death"
We shall conquer
Ing. Alberto Parjús
Superintendent





ASPHALT coating is spread by this device on the floors of channels and other waterways in the Netherlands to cut down erosion from swift water. Asphalt is hauled from a deck mixer by cart and dumped into the device's reservoir.

Device Paves Channels to Fight Water Erosion

ASPHALT is being used in Holland to help protect the country from its age-old enemy, the sea.

Engineering studies showed that a "carpet" of asphalt on the floor of a waterway could cut down erosion from swift water.

The next step was development of a machine which could lay asphalt in channels and other waterways. This was accomplished by engineers of Royal Dutch-Shell Laboratories.

Now the machine is being given extensive tests by the Netherlands State Water Board.

It has worked successfully in curbing channel erosion in water depths up to 24 ft. in areas where stream flow was as much as 5 ft. per second.

New tests are being carried out at 50 and 60 ft.

The technique worked well in the big Delta project, a vast system of dams which are being built to reclaim and protect large areas of the Netherlands.

Australia Discovery Shut In

- **Cabawin wildcat rated at 60 bbl. daily after flowing 23 days. Further testing will precede second wildcat.**

THE RECENT oil discovery made in Australia by Union Oil Co. has been shut in after producing for 23 days at the rate of 60 bbl. of oil and 500,000 cu. ft. of gas.

A company spokesman says this is substantially the potential of the well, Australia's best oil show since Rough Range in 1953.

Production came from a thin Permian zone of about 7 or 8 ft. of sand below 9,928 ft. The oil is 50°-gravity crude.

Production flowed through a 22/64-in. choke with a tubing pressure of 250-300 psi. and a casing pressure of 550-600 psi.

The wildcat, Cabawin 1, tested at rates ranging from 62 to 85 bbl. daily during a series of production tests (OGJ, May 15, p. 120).

A second test is planned on a 40-million-acre block the company holds in Queensland and New South Wales, but a definite location has not been staked.

Additional testing up the hole in the Cabawin well will be completed before another well is spudded.

Union holds Australian acreage along with Kern County Land Co., and Australia Oil & Gas Corp.

Another show . . . Southeast Oil Syndicate, a group of Australian investors, is expected to spud a 5,000-ft. wildcat, Beachport 1, early in June southeast of Adelaide in South Australia.

The group had a slight gas kick that was largely methane in its Penola 1, a 4,985-ft. wildcat drilled about halfway between Adelaide and Melbourne.

This show came from 4,200 ft., where the drill pipe twisted off.

The Penola well has been suspended and the operation moved 40 miles southwest to the Beachport location.

Southeast Oil Syndicate has a farmout on 20 sq. miles from General Exploration Co. of Australia, a company-owned 50-50 by General Exploration Co. of California and Santos, Ltd.

Colombian Discovery Hailed

. . . as one of best in recent years. Cities Service says tests indicate chance of substantial reserves.

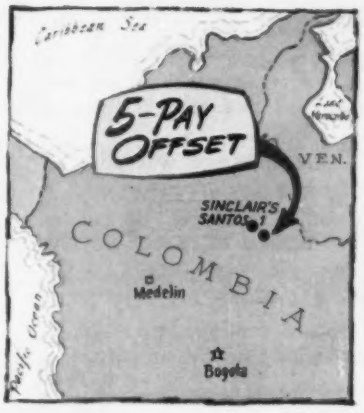
COLOMBIAN exploration play took on a rosy glow last week as Colombia-Cities Service Petroleum Corp. dually completed one of the most promising oil wells found in the country in years.

The company's Payoa 1, in the middle Magdalena Valley, tested at the total rate of 5,410 bbl. daily from five zones.

Payoa 1 is about 160 miles north of Bogota. The well, on the eastern edge of a 75,000-acre block, offsets Sinclair Colombian's Santos 1 discovery which lies about 1.5 miles north-northwest (OGJ, Aug. 1, 1960, p. 104).

Cities Service says "production tests on the well to date indicate the possibility of substantial reserves."

The company is operator on the block for itself and three partners.



Santos field . . . Sinclair's latest well in the area, Santos 3, reportedly came in as a good well. This gives Sinclair three for three in the vicinity.

Santos 1, which may tap the same oil pool as Payoa, was dually completed with a reported flow of 2,500 bbl. daily through a 34/64-in. choke from a zone topped at 8,809 ft., and 1,644 bbl. daily through a 23/64-in. choke from a zone at 8,809 ft.

Results of Tests on Payoa

Depth	Time	Choke	Oil Flow	Gravity
6,895-6,929 ft.	1½ hr.	½ in.	94 bbl.	23.1
6,952-6,999 ft.	2½ hr.	½ in.	130 bbl.	23.9
7,742-7,764 ft.	6 hr.	½ in.	29 bbl.	27.7
7,932-7,958 ft.	4 hr.	⅜-in.	56 bbl.	29.3
8,278-8,388 ft.	10 hr.	Various	920 bbl.	35

Conoco buys UK distributor in marketing drive

CONTINENTAL Oil Co. has taken a second step into European marketing with the purchase of Jet Petroleum, an independent distributor in England.

Jet sells gasoline through 30 to 40 retail outlets. It has been in the spotlight in recent months as a cut-rate chain which based operations on oil imports, largely Venezuelan, picked up at bargain prices.

The company has a terminal at North Scunthorpe, Lincolnshire.

Continental acquired all capital stock for an undisclosed price.

Last year Continental took its first step into European marketing by acquiring control of Sopi Mineralprodukte G.m.b.H., one of the biggest independent marketing organizations in West Germany and Austria. "Sopi" markets products through approximately 360 retail outlets (OGJ, Aug. 1, p. 103).

The moves in England and Germany will give Continental an outlet for some of its Libyan crude.

FOREIGN BRIEFS . . .

Union Oil is fishing at 10,000 ft. in the Daora 1-1 wildcat in the Spanish Sahara. The wildcat is the first deep test spudded in the area. It is scheduled to go to 13,200 ft. or to basement.

A second pay has been found in an offshore extension to Belayim field off Egypt's Sinai Peninsula. The new zone, discovered at 9,265 ft. by Cie. Orientale des Petroles d'Egypte, doubled the total test flow of the well to 3,780 bbl. daily (OGJ, May 29, p. 120).

Seismographic exploration is under way on 280,000 acres in Turkey which were farmed out by Panoil Co., Dallas, to San Jacinto Petroleum, Houston. The acreage is along the Mediterranean shore near a refinery being built by Mobil-Shell-British Petroleum interests at Mersin. San Jacinto has agreed to contribute dry-hole money toward the cost of drilling a Mobil test 1.5 miles from a Panoil-San Jacinto block.

A Bolivian oil and gas discovery has been made by Tennessee Gas Transmission on its 443,400-acre lease held jointly with Union Texas Natural Gas, Lion Oil, and Murphy Corp. Chaco Petroleum, SA, a TGT subsidiary, found gas condensate or oil in two zones in Algarrobille 1, 40 miles north of the Bolivian-Argentine border city of Yacuiba. Rates of production in the 12,890-ft. well won't be available until final testing.

A planned 6,000-ft. wildcat has been spudded by Delhi Australian Petroleum, Ltd., on Mornington Island in the Gulf of Carpentaria off northern Australia. The project, on a concession owned 50-50 by Delhi and Santos, Ltd., reportedly will be looking for gas despite the great distance from any population center. It is also reported that the gas might be used to fuel bauxite-mining operations near at hand in northwestern Queensland.

New World Flow Record May Be Last in Skein

FREE-WORLD crude production in March was kept at an all-time high by a new record in Kuwait and big gains in the U. S.

But the margin over February was nothing spectacular and the April figures, when available, are expected to show that a string of record months has been broken.

Kuwait's record of 1,868,200 bbl. daily in March was propped up by a gain of nearly 200,000 bbl. daily in U. S. production.

Total free-world output for the month was almost 19 million barrels daily.

Production cuts in both Canada and Venezuela dropped the Western Hemisphere—excluding the U. S.—below the February level.

Output from French fields in the Sahara continues to make its mark in world production. It has been inching up for months.

TREND OVER THE LAST YEAR
(Thousands of barrels)

	Western Hemisphere less U. S.	Middle East	Total free world outside U. S.
1960			
March	4,173.6	5,141.7	10,353.4
April	4,069.5	4,925.5	10,055.1
May	4,317.4	5,286.2	10,680.2
June	4,285.4	5,164.5	10,568.2
July	4,214.2	5,103.5	10,448.2
August	4,420.1	5,146.8	10,602.5
September	4,311.3	5,500.2	10,941.3
October	4,243.9	5,630.6	11,104.5
November	4,206.8	5,482.2	10,964.2
December	4,341.2	5,550.1	11,152.2
1961			
January	4,594.1	5,568.1	11,418.8
February	4,616.9	5,697.7	11,573.8
March	4,446.9	5,773.6	11,519.3

World-Wide Crude Production: Daily average in Thousands of Barrels

Country—	Mar. 1961	Feb. 1961	Mar. 1960
Western Hemisphere			
Argentina	233.2	231.6	139.1
Bolivia	9.2	8.1	8.0
Brazil	92.0	92.0	76.3
Canada	516.0	577.2	560.9
Chile	21.9	21.9	19.0
Colombia	147.6	145.6	156.1
Cuba	0.2	0.2	0.5
Ecuador	8.1	8.3	7.4
Mexico	271.0	271.0	270.2
Peru	52.8	52.5	51.0
Trinidad	126.5	126.5	119.4
Venezuela	2,968.4	3,082.0	2,765.7
Total	4,446.9	4,616.9	4,173.6
Europe			
Austria	44.7	44.5	46.4
France	40.5	41.4	36.5
West Germany	116.2	114.6	105.1
Italy	34.4	38.3	32.1
Netherlands	39.4	39.1	34.4
United Kingdom	1.7	1.7	1.8
Yugoslavia	24.4	22.2	11.7
Total	301.3	301.8	268.0
Middle East			
Bahrain	45.1	45.0	45.1
Iran*	1,102.0	1,167.0	1,065.0
Iraq†	948.5	984.8	938.3
Israel	2.3	2.3	2.5
Kuwait	1,868.2	1,615.5	1,600.2
Neutral Zone	151.4	152.2	128.0
Qatar	177.0	177.3	180.0
Saudi Arabia	1,472.1	1,547.2	1,175.3
Turkey	7.0	6.4	7.3
Total	5,773.6	5,697.7	5,141.7

Country—	Mar. 1961	Feb. 1961	Mar. 1960
Other Asia			
British Borneo	92.0	92.0	101.3
Burma	10.5	10.5	12.4
India	8.5	8.5	8.5
Indonesia	414.2	391.7	408.3
Japan	11.5	11.7	9.0
New Guinea	4.0	3.4	4.2
Pakistan	5.9	5.9	5.9
Total	546.6	523.7	549.6
Africa			
Algeria	339.4	323.1	123.4
Angola	1.5	1.5	1.1
Egypt	71.7	70.2	62.3
Gabon	14.9	15.4	15.4
Middle Congo	2.0	2.1	.....
Morocco	1.8	1.8	2.1
Nigeria	19.6	19.6	16.2
Total	450.9	433.7	220.5
Free World			
Foreign	11,519.3	11,573.8	10,353.4
United States	7,470.8	7,296.0	7,128.0
Total	18,990.1	18,869.8	17,481.4
Communist Countries in Soviet Orbit			
Romania	231.0	231.0	231.0
Russia	3,170.0	3,170.0	2,843.0
Other Communist	100.0	100.0	100.0
Total	3,501.0	3,501.0	3,174.0
WORLD TOTAL	**22,491.1**	**22,370.8**	**20,655.4**

Figures are from reliable industry reports or government sources. Estimates are made where complete reports are lacking. *Includes estimated 6,000 bbl. daily from Naft-i-Shah field not operated by consortium companies. †Includes estimated 3,500 bbl. daily from Naft Khaneh field, operated by Iraq Government.

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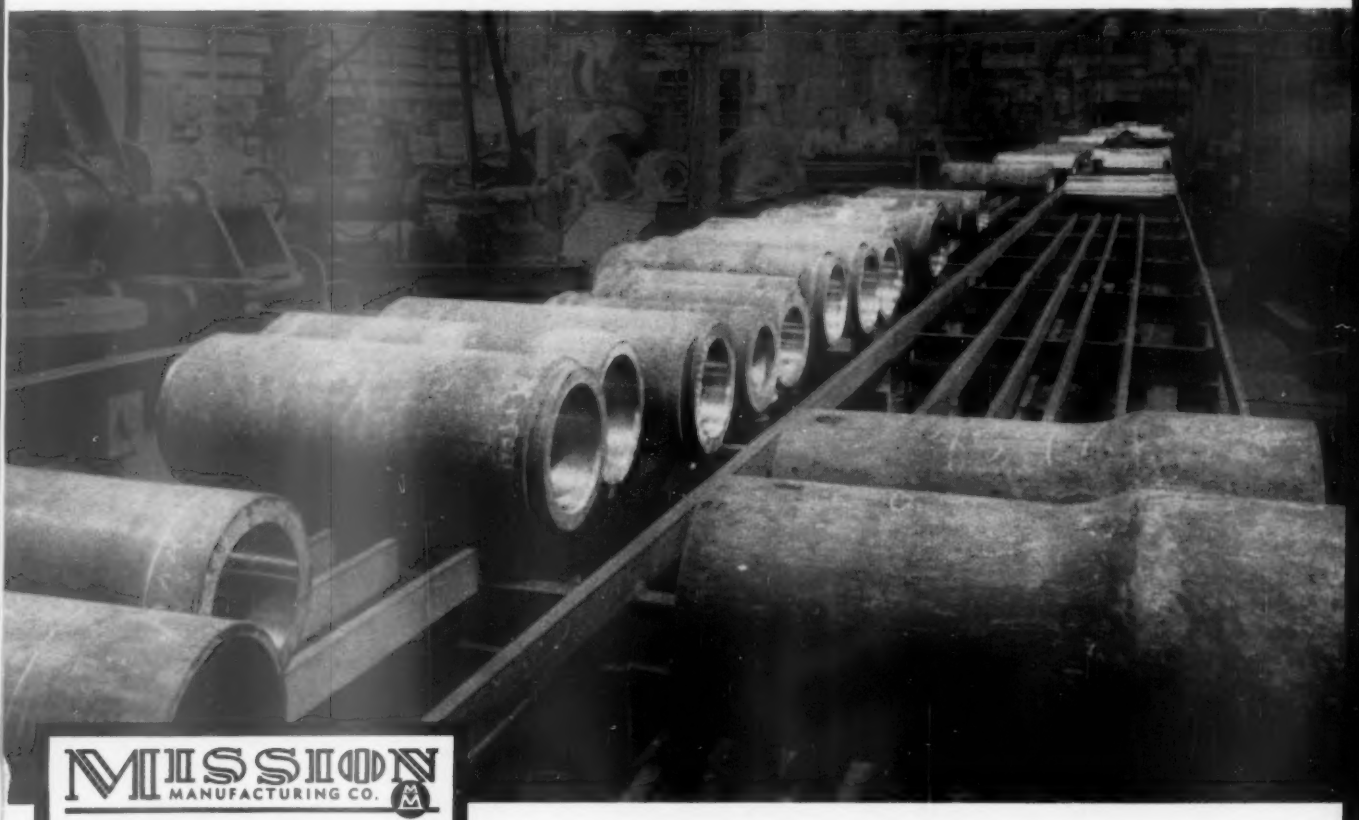
specify Mission all the way for greater pump efficiency



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How to engineer an

IN SITU COMBUSTION PROJECT

Here's an article that goes a step beyond the theory, experimentation, and field results that have been published before. This one outlines a procedure for the petroleum engineer to follow as a guide in setting up a full-scale thermal recovery project.

BY T. W. NELSON AND J. S. McNEIL
Socony Mobil Oil Co., Inc.

WHAT DATA do we need? What do we do first? What's the second step, and so on?

These are the questions that face the petroleum engineer when it is time to consider the possibility of starting an in situ combustion project. Let's take a look at these and other questions.

Of first importance. Evaluation of commercial possibilities of an in situ combustion recovery process can't begin until we know these things:

- Total amount of air required.
- Rate and pressure at which this air must be supplied.
- Total amount of oil that will be produced.
- Rate at which this oil will be produced.
- Operating expenses.

Total air needed. In any combustion reaction, amount of air required is governed by the amount of fuel burned, and the efficiency of oxygen utilization. It has been found from laboratory experiments with a number of heavy crude oils, and from observations in the field, that fuel consumed in an in situ combustion process usually falls in the range of 200 to 300 bbl. per acre-ft. of formation burned. Multiplying by the total number of acre-feet burned in the process, the total fuel consumption is found, and this determines the amount of air needed.

This article is based on a lecture presented at University of Texas.

The range between 200 and 300 bbl. per acre-ft. is a fairly broad one to choose from, and a wrong assumption could affect the results of an evaluation appreciably. Therefore, it is best to determine this figure as accurately as possible for the particular crude oil and reservoir conditions involved. This is usually done in a burning tube in the laboratory—an insulated, cylindrical vessel, usually 4 to 8 in. in diameter and 4 to 10 ft. long. The tube is packed with sand, water, and the crude oil in question, simulating as nearly as possible reservoir conditions of porosity and saturation. When this tube is burned, observations are made of the amount and rate of air injected, the amount of oil and water produced, and the amount and composition of gas produced. Fuel consumption is determined on the basis of the amount of the sand pack burned and the amount of composition of the produced gas as illustrated below.

The experimental data needed from the laboratory tube run are:

I.d. of combustion tube, ft.	D
Length of pack burned, ft.	L
Porosity, %	ϕ
Volume of produced gas (dry basis), s.c.f.	V_g
Composition of injected air	
Nitrogen, vol. %	N_{2a}
Oxygen, vol. %	O_{2a}
Composition of produced gas	
Nitrogen, vol. %	N_{2g}
Oxygen, vol. %	O_{2g}
Carbon dioxide, vol. %	CO_{2g}
Carbon monoxide, vol. %	CO_g

The combustion equation involved in this process is:

Air (nitrogen + oxygen) + fuel (carbon + hydrogen) → Nitrogen + carbon dioxide + carbon monoxide + water + unreacted oxygen (1)

It is assumed that nitrogen is completely inert in the reaction, and that none is accumulated in the sand pack during the burning run. This means that the amount of nitrogen injected equals the amount produced.

The first problem is to calculate the quantities of material involved in the above equation for the case of the laboratory tube run. This is done as follows:

Nitrogen produced
$$= (V_g \times N_{2g}/100)\ \text{(s.c.f.)} \quad (2)$$

Nitrogen injected
$$= \text{nitrogen produced} = (V_g \times N_{2g}/100)\ \text{(s.c.f.)} \quad (3)$$

Oxygen injected
$$= (V_g \times N_{2g}/100) \times (O_{2a}/N_{2a})\ \text{(s.c.f.)} \quad (4)$$

Carbon dioxide produced
$$= (V_g \times CO_{2g}/100)\ \text{(s.c.f.)} \quad (5)$$

Carbon monoxide produced
$$= (V_g \times CO_g/100)\ \text{(s.c.f.)} \quad (6)$$

Unreacted oxygen produced
$$= (V_g \times O_{2g}/100)\ \text{(s.c.f.)} \quad (7)$$

Carbon in fuel burned
$$= [(V_g \times CO_{2g}/100) + (V_g \times CO_g/100)] \times (12/379) = W_c\ \text{(lb.)} \quad (8)$$

Water formed by combustion
$= 2\,[(V_g \times N_{2g} \times O_{2a}/100\,N_{2a}) - (V_g \times O_{2g}/100) - (V_g \times CO_{2g}/100) - (\tfrac{1}{2})\,(V_g \times CO_g/100)] \times (18/379) = W_w$ (lb.) (9)

Hydrogen in fuel burned
$= 2\,[(V_g \times N_{2g} \times O_{2a}/100\,N_{2a}) - (V_g \times O_{2g}/100) - (V_g \times CO_{2g}/100) - (\tfrac{1}{2})\,(V_g \times CO_g/100)] \times (2/379) = W_H$ (lb.) (10)

Total weight of fuel burned is then $W_C + W_H = W_F$ (lb.) (11)

Next step is to relate the fuel burned to the amount of sand burned in the laboratory tube.

Volume of sand burned
$= \pi\, D^2\, L/4$ (cu. ft.) (12)

Pounds of fuel consumed/cu. ft. of sand burned $= 4\,W_F/\pi\,D^2L = W$ (13)

Pounds of fuel consumed/acre-ft. of reservoir burned = 43,560 WF (14)

Where:

$F = (100 - \phi_R)/(100 - \phi_V)$ and ϕ_R is the porosity of the reservoir. This quantity corrects for any difference in the density of the laboratory sand pack and that of the reservoir. The next step is to relate the fuel burned to the total air injected, and then in turn to relate the latter to the volume of sand burned.

Total air injected
= nitrogen injected
+ oxygen injected

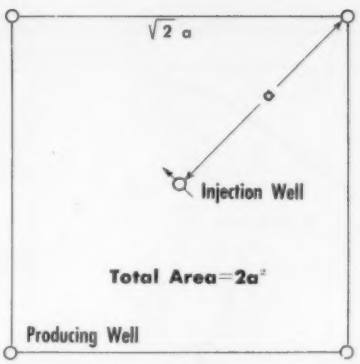
$= (V_g \times N_{2g}/100) + (V_g \times N_{2g}/100)\,(O_{2a}/N_{2a}) = V_a$ (s.c.f.) (15

Air injected/lb. of fuel consumed
$= V_a/W_F$ (s.c.f./lb.) (16)

Air injected/cu. ft. of reservoir burned $= V_a/W_F \times WF = 4V_aF/\pi\,D^2L = A$ (s.c.f./cu. ft.) (17)

Air injected/acre-ft. of reservoir burned
$= 43{,}560\ A/10^6$ (M.M.s.c.f./acre ft.) (18)

Total air needed to burn a given well pattern in the field depends on unit air consumption, Equation 18, and the volumetric sweep efficiency



AREAL SWEEP EFFICIENCY depends on the well pattern involved. One of the simplest to use, and the most common, is the five spot. Fig. 1.

in the burning operation. In the present instance, the volumetric sweep efficiency is assumed to be the product of areal sweep efficiency and vertical sweep efficiency.

Areal sweep efficiency depends on the well pattern involved. One of the simplest to use, and the most common, is the five-spot, Fig. 1. The areal sweep efficiency for a developed five-spot pattern at infinite mobility ratio has been found by laboratory model studies to be 62.6%. An infinite mobility ratio is believed to represent the flow conditions during the burning process.

Core data from field tests have shown that vertical sweep efficiency varies from as low as 35% to as high as 90%. However, in order that the calculations for air requirement will have a reasonable factor of safety in them (to account for air bypassing the front and for the possibility of poorer oxygen utilization in the field than in the laboratory combustion tube run), it is recommended that 100% efficiency be assumed.

On this basis then, the volumetric efficiency becomes $62.6 \times 100/100 = 62.6\%$ and the air requirement per acre-foot in the five-spot field pattern becomes

Air injected/acre-ft. of pattern
$= (0.626)\ 43{,}560\ A/10^6 = 27{,}269\ A/10^6$ (M.M.s.c.f./acre-ft.) (19)

To calculate the total air requirement for the entire five-spot pattern in the field, the above value is multiplied by the volume of the pattern which is determined by the distance between injection and producing wells (a) and by the thickness of the formation (h), both in feet.

Total air required for five-spot field pattern
$= 0.626\ A\ (2a^2h)/10^6$ (M.M.s.c.f.)
$= V_T$ (20)

Air Rate and Pressure

Rate at which air needs to be supplied depends on the desired rate of advance of the burning front. The faster the burning front advances, the faster the pattern burns, and the faster the oil is produced. Thus it is desirable to operate with as high a rate of advance of the burning front as possible in order to get maximum rate of oil production and hence maximum rate of return on equipment. From a practical operating standpoint, the permissible range of rate of burning-front advance is limited on the high end by the ability of the producing wells to handle the oil, and on the low end by the minimum needed to sustain combustion. Field and laboratory experience shows that a satisfactory burning rate is 0.125 to 0.5 ft. per day. This range was developed for formation thicknesses of about 20-30 ft. and would probably not apply to very thin or thick formations.

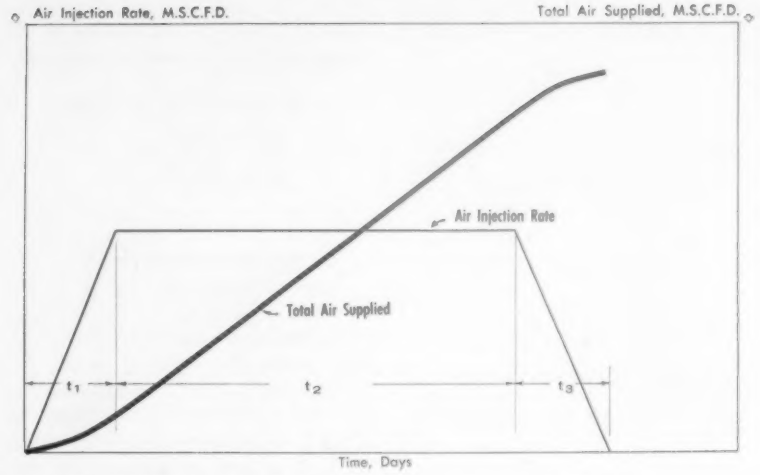
In actual air-rate calculations, effect of rate of burning-front advance (v, ft. per day) is expressed in terms of "air flux" (u) which is the volume of air required per square foot of burning-front area per day. From the air requirement per cubic foot of formation (A), Equation 17, the air flux for any rate of burning-front advance can be found by:

$u = Av$ (s.c.f. per day-sq. ft. (21)

If it is desired to burn through a cubic foot of formation linearly at a rate of 0.125 ft. per day (the minimum indicated above), the total burning time will be 8 days and the air will have to be supplied at a rate equivalent to

$A \times 1/8 = V_a\,F/2\,\pi\,D^2L$ (s.c.f. of air per day-sq. ft. of burning-front area) (21a)

This air flux value for a burning-front advance of 0.125 ft. per day



AIR REQUIREMENTS for inverted five-spot well pattern. Fig. 2.

will be referred to again in the calculation of total air rates to use in the operation.

Another factor which governs the rate at which air should be supplied is the limited areal sweep which results when the air flux in certain regions of the burning perimeter falls below that necessary to sustain combustion. This effect is represented for calculation purposes by a dimensionless flow term (i_D) developed from laboratory potentiometric model studies. This term established the air injection rate needed to achieve a given sweep efficiency of the combustion zone for any specified condition of minimum flux, and relates the air-injection rate to minimum flux and patterns dimensions by the following expression:

$$i_D = i_a/u_{min}\, ah \qquad (22)$$

Where:

i_a = maximum pattern air rate, s.c.f. per day

u_{min} = minimum air flux to sustain combustion; s.c.f. per day-sq. ft. of burning-front area

For a five-spot pattern this term varies with sweep efficiency at break-through as shown in the following table.

i_D	Areal sweep efficiency at breakthrough
3.39	50.0%
4.77	55.0%
6.06	57.5%
∞	62.6%

Although total air requirement for the five-spot pattern was calculated earlier on the basis of 62.6% areal sweep efficiency, the table shows that infinitely high air rates are needed to get this areal sweep efficiency. In the air-rate calculation, therefore, the procedure is to use the highest efficiency that will give a reasonable value of i_D and hence a practical and economic rate of air supply to use. For the five-spot pattern involved in the present procedure, this is taken to be 55% with a corresponding value of i_D of 4.77.

The first step in calculating an air-rate schedule for the field unit is to calculate a maximum air rate that will be used on a constant basis during most of the burning operation. This should be based on the i_D for a 55% areal sweep and on the air flux corresponding to 0.125 ft. per day of burning-front advance:

$$\begin{aligned}\text{Air rate (s.c.f. per day)} &= i_a \\ &= i_D u_{min} ah = i_D u_{min} ah \\ &= 4.77\ A(0.125)ah \qquad (23)\end{aligned}$$

The next consideration is the schedule for increasing the air rate from the start of air injection until the maximum rate calculated above is reached. This is based on moving the burning front out from the injection well at a rate of burning front advance (v_1) of 0.5 ft. per day, which is the maximum indicated previously for use in this procedure. Laboratory model studies show that the movement of the burning front during the early stages of burning (up to an areal sweep of about 10% of the pattern area) will be essentially radial. Further, it can be shown that if the front velocity (v_1) in the increasing rate period exceeds the minimum burning velocity by a factor of three or greater, the constant maximum injection rate will be reached before 10% of the pattern area has been swept, regardless of the pattern size. Thus the air rate will increase linearly from the start of injection up to the value calculated above, according to the relation,

$$\text{for } r_f < r_1, \qquad i_1 = 2\,\pi\, rhu_1 \text{ (s.c.f. per day)} \qquad (23a)$$

$$\text{and for } r_f \geqq r_1,\ i_a = 2\,\pi\, r_1 hAv_1 \text{ (s.c.f. per day)} \qquad (23b)$$

where r_f = radial distance to burn zone (ft.)

and r_1 = radial distance to burning zone at end of increasing rate period, ft.

Therefore the time in days, t_1, required for the increasing-rate period of the operation is

$$t_1 = r_1/v_1 = i_a/2\pi hAv_1^2 \text{ (days)} \qquad (24)$$

and the volume (V_1) of air injected during this period is

$$V_1 = t_1\, i_a/2 \times 10^6 \text{ (M.M.s.c.f.)} \qquad (25)$$

Next it is assumed that there will be a similar time period and a similar volume of air injected during the final stage of the burning operation when the air rate is decreased linearly from the maximum value i_a back to zero. These we will call t_3 and V_3 respectively and by this assumption $t_3 = t_1$ and $V_3 = V_1$.

In Equation 20 the total air, V_T, required to burn the five-spot pattern in the field was determined. Then the amount of air, V_2, that will be injected at the maximum air rate is this total less the amount used in the startup and shutdown periods as calculated, or

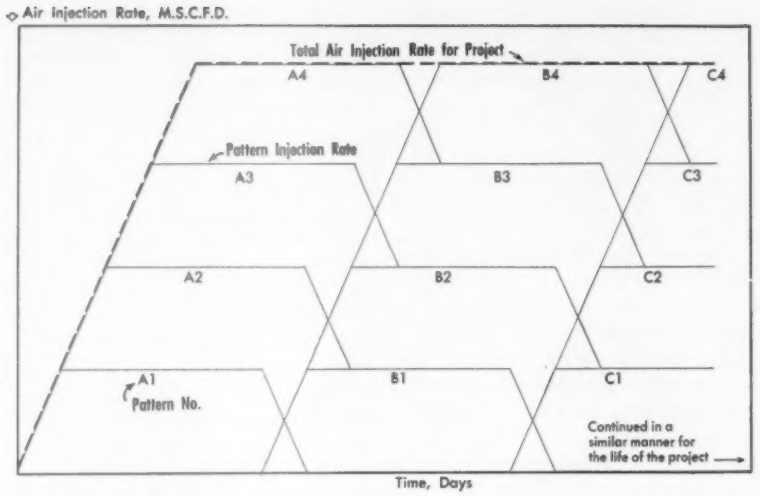
$$V_2 = V_T - V_1 - V_3 \text{ (M.M.s.c.f.)} \qquad (26)$$

and the time required for this part of the operation is

$$t_2 = 10^6\, V_2/i_a \text{ (days)} \qquad (27)$$

Total time required for the entire burning operation is

$$t_t = t_1 + t_2 + t_3 \text{ (days)} \qquad (28)$$



AIR-INJECTION SCHEDULE for operating a project with a number of five-spot patterns. Fig. 3.

From the above calculations, an air rate vs. time curve can be plotted, Fig. 2.

It is obvious from the air-rate curve, Fig. 2, that it would not be economic to operate a single pattern by itself because there would be an excessive amount of idle compressor capacity during the initial and final stages of the burning operation. However, the solution to this problem is equally obvious: operate several patterns simultaneously, but stagger those patterns so that the peak air demands for some correspond with periods of low air demand for others so as to give a constant demand on the compressor station.

We have found that an arrangement of four patterns operating simultaneously but staggered in operating sequence by t_1 provides a constant load on the compressor installation. Such an arrangement is shown diagrammatically in Figs. 3 and 4. The process is made continuous in the field by starting a new sequence of patterns when the injection rate on the previous sequence of patterns starts to decline. Multiples of this arrangement can, of course, be used if the field is large and if it should be desirable to install a larger compressor plant in order to achieve economies from large-scale operation.

The most reliable method of determining the required air-injection pressure is to run actual injection tests in the field. However, this is not possible or practical many times, particularly for preliminary appraisals of in situ combustion projects. So a calculation method is used for approximating the pressure that will be required. The equation used, a modification of the well-known equation for steady-state flow in a developed five-spot pattern, is derived in Appendix A. Its use is justified on the basis that the burning front is still radial at the point of maximum pressure requirements (which is the point where maximum air rate is first reached). The relationship is as follows:

$$P_{iw}^2 = P_w^2 + (i_a \mu_a T_f/0.703\, k_g h) \times [\ln (a^2/r_w v_1 t_1) - 1.238] \quad (29)$$

Where:

P_{iw} = injection-well bottom-hole pressure, psia.

P_w = production-well bottom-hole pressure, psia.

i_a = maximum air rate, s.c.f. per day.

μ_a = viscosity of air, cp.

T_f = formation temperature, °R.

a = well spacing, ft.

t_1 = time to reach maximum air rate, days.

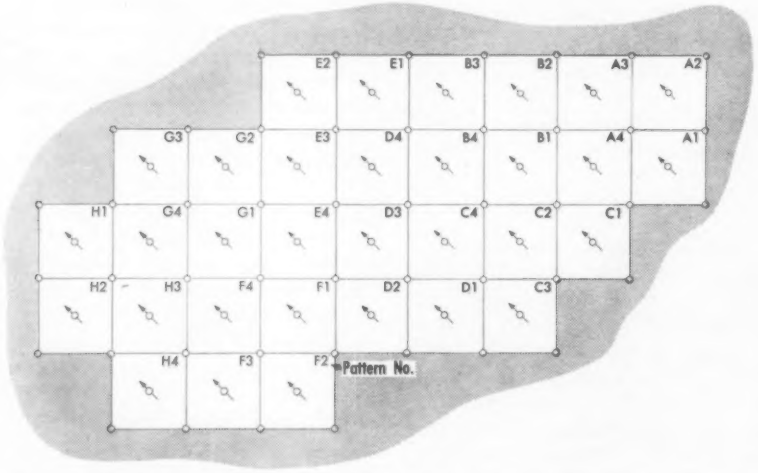
k_g = effective permeability to air, md.

h = formation thickness, ft.

r_w = production-well radius, ft.

Values for the terms i_a and t_1 will be available from previous calculations, and "a" and h are determined by the size of the field unit being used. P_w is usually assumed to be atmospheric on the basis that the production-well bores will be kept drained at the time of maximum injection pressure. T_f can be measured in the field and μ_a is based on this temperature. The effective gas permeability, k_g, must also be estimated; if no information is available on which to estimate k_g, it is recommended that a value of 5% of the specific permeability be used.

After finding the air rate and pressure needed to conduct the field operation, the size of compressor plant can be calculated. This is done by calculating the stages of compression required to reach the necessary injection pressure, and using standard compressor-horsepower charts.



WELL-LAYOUT DIAGRAM for developing a field with a number of five-spot patterns. Fig. 4.

Total Amount of Oil Produced

The mechanisms by which oil is produced during combustion have

not yet been fully clarified. But, the total amount of oil displaced by the combustion front is dependent on the volumetric sweep of the front. Core information from field tests has shown that, in addition to oil displaced in this manner, much oil is produced as a result of depletion of unburned but heated regions adjacent to the burned zone. With the 55% areal sweep (E_A) used in the previous air-requirement calculations, and an over-all vertical sweep or invasion efficiency (assumed uniform over the producing area) of 55% (E_1), the volumetric pattern sweep of the burned zone is calculated as

$$E_V = E_1 E_A = 0.55 \times 0.55 \times 100 = 30\% \quad (30)$$

The quantity of oil displaced from the burned-out zone can now be calculated as the difference between original oil content and the quantity consumed as fuel, Equation 14. For this purpose the fuel is assumed to have a gravity of 10° API (sp. gr. = 1), generally somewhat lower than the gravity of the reservoir crude oil as a result of distillation and cracking.

Oil displaced/acre-ft. of reservoir burned = N_1

$$= 43{,}560\,[(S_o \phi_R/5.61 \times 10^4) - (WF/350)] \text{ (bbl./acre-ft.)} \quad (31)$$

where S_o = oil saturation, % of pore space, 350 is density of 10° API oil in pounds per barrel, and 5.61 is the number of cubic feet in a barrel.

In the unburned sections of the formation, the amount of oil displaced depends on crude-oil viscosity (a function of temperature conditions imposed by the proximity of the combustion zone), reservoir permeability, gravity drainage, and the rate and quantity of displacing fluids (bypassing air or combustion gases) moving through the unburned formation. Core analysis from field experiments shows that, in a heavy-oil reservoir, more than half of the oil in those portions of the pattern either bypassed vertically or not reached by the front may be produced by the combination of hot-gas drive and gravity drainage. For the purposes of this design procedure, an average recovery efficiency of 40% is assumed for the unburned portion of the reservoir. Thus,

Oil displaced/acre-ft. of unburned reservoir

$$= N_2 = 43{,}560\,(0.40)\,S_o \phi_R/5.61 \times 10^4 \text{ (bbl./acre-ft.)} \quad (32)$$

The over-all oil recovery is then given by

Total oil recovered/acre-ft.

$$= N_3 = E_V N_1/100 + (100 - E_V) N_2/100 \text{ (bbl./acre-ft.)} \quad (33)$$

And the over-all oil-recovery efficiency is:

$$E_R = \frac{N_3 \times 5.61 \times 10^6}{43{,}560\,S_o \phi_R} \ (\%) \quad (34)$$

Also to be considered, especially for the purpose of designing separation equipment, is the amount of water produced by the process. Core-analysis data are inconclusive, and for our purposes the assumption is made that average water saturation in the unburned part of the reservoir remains constant. Thus total water production is calculated as the sum of combustion water plus the water originally contained in the burned volume of the reservoir. In terms of reservoir properties and combustion tube run parameters,

Total water produced/acre-ft. of reservoir

$$= 43{,}560\,E_V/100 \times [(4W_w F/350\,\pi D^2 L) + (S_w \phi_R/5.61 \times 10^4)] \text{ (bbl./acre-ft.)} \quad (35)$$

where S_w = original water saturation in reservoir, %.

Rate of Oil Production

Field performance of in situ combustion operations shows that oil-production rates increase slowly at first and then more rapidly as heat penetrates to producing wells. They usually reach a maximum during the first half of the operating schedule, and then decline gradually for the remainder of the recovery operation. However, detailed production-rate history may be expected to vary from one reservoir to another, and in the absence of more specific information a reasonable design procedure is to assume that oil-production rate is proportional to air-injection rate; i.e., the injected-air to produced-oil ratio remains constant. Errors in sizing production facilities on this basis may be appreciable for a pilot test, or single-pattern operation, but operation of multiple patterns scheduled on a staggered basis should result in a relatively constant field production rate.

Rate of oil production is calculated by multiplying the values obtained for air-injection rate in M.M. s.c.f.d. by the number of barrels of oil produced per M.M.s.c.f.d. of air injected.

Oil recovered/M.M.s.c.f. of air injected

$$= \left(\frac{E_V N_1}{100} + \frac{(100 - E_V) N_2}{100}\right) \frac{10^6}{27{,}269\,A} \text{ (bbl./M.M.s.c.f.)} \quad (36)$$

It should be obvious that the oil-production rate curve will have the same shape as the air-rate curves in Figs. 2 and 3.

Water-oil ratio is assumed constant throughout the production history of the reservoir. This proceduce appears to be a safe one for purposes, since available field evidence indicates that water production is likely to be somewhat lower during the flush period of oil production than during the period of declining production, tending to equalize over-all fluid rates. The method described above for determining oil rates (on the basis of a constant oil-air ratio) can also be used for determining water-production rates. The amount of water produced per M.M.s.c.f. of air injected is given by:

Water produced/M.M.s.c.f. air

$$= 43{,}560\,(E_V/100) \left(\frac{4W_w F}{\pi D^2 L\,(350)} + \frac{S_w \phi_R}{5.61 \times 10^4}\right) \times 10^6/27{,}269\,A \text{ (bbl./M.M.s.c.f.)} \quad (37)$$

Costs Involved in the Operation

Specific items of investment and operating cost are not presented here because cost figures vary a

great deal, depending on the type of equipment, the size of the operation, and the area involved. However, cost information for a specific project can usually by obtained without much effort by contacting suppliers and referring to the trade literature. Also, an example of the costs that might be encountered in an in situ combustion project in the Mid-Continent have been presented in an article entitled "Three Ways to Improve Oil Recovery" (OGJ, Jan. 19, 1959, p. 86). Additional information on in situ combustion can be located by reference to Bureau of Mines Information Circular 7958.

Compressor plant. The size of the compressor plant required has been calculated previously. Cost data are readily available from suppliers for various types of compressor installations.

The piping required to deliver air from the compressor plant to the injection wells will depend on the location of the compressors on the property. One suitable solution to this problem is to locate the compressor plant centrally on the property and move the air piping from time to time as the burning operation progresses through the field. Once the piping has been sized for the volumes and pressures of air involved, the investment, installation, and moving costs can be readily estimated.

Operating costs for the compressor plant should be based on labor and material costs in the area under consideration.

Well drilling. Well-drilling costs should be estimated on the basis of drilling injection and producing wells only as needed during the life of the project. This procedure will keep the current investment at a minimum and improve the over-all economics of the process.

Pumping units. Size of pumping units required is based on the oil-production schedule for individual wells as calculated previously. Only enough pumping units should be acquired to operate the producing wells that are involved at any given time. As patterns become burned out, and new patterns are added, pumps can be removed from the previous producing wells and after reconditioning, they can be installed in the new producing wells. Costs are readily available from suppliers for various types of sizes of pumping equipment, and the reconditioning and moving costs can be estimated on the basis of labor and material costs in the area.

Lease equipment. In general, design and location of lease equipment on the property can follow conventional oil-field practice for production of heavy oil. Important variations from this practice that should be considered are the use of heavy-duty treating equipment (to handle severe emulsions that may occur) and the use of special liners, well-cooling, and corrosion-control equipment (add perhaps $3,000 per producing well for equipment necessary to protect against high temperatures and unusual corrosion conditions). It may also be desirable to consider special equipment for processing the produced gas to recover small amounts of light hydrocarbons and oxidized materials, or for removing sulfur compounds to avoid air pollution in certain areas.

Sizing of the flow lines, separator equipment, heater treaters, stock tanks, and other related equipment will be dependent on the oil-production schedule calculated earlier.

Lease operation. The cost items to be considered here are labor (well pumpers), well maintenance (workovers, etc.), and electric power for the pumping units.

Special corrosion problems may occur as a result of the temperatures and unusually corrosive conditions. It is recommended that well-maintenance costs for this operation be estimated at least twice as high as for conventional production operations in the area.

Over-all economics. The over-all economics of an in situ combustion project can be calculated considering the operating costs and revenues year by year over the life of the project in a convetional profit-and-loss analysis. In addition to the items discussed above, royalties, taxes, and other business expenses should, of course, be included in this over-all analysis. It would probably be desirable to express the results in terms of several profit parameters such as discounted cash flow-rate of return, payout, dollars per dollar invested, and cents per net barrel of oil produced.

Example problem

An example problem in in situ combustion is presented as a means of familiarizing the practicing engineer with the design procedure discussed previously. The correct answers to the various parts of this problem are presented as Appendix B.

The following data are given:

Laboratory data

I.d. of combustion tube, ft.		1/3
Length of pack burned, ft.		6
Porosity, %		35
Volume of produced gas (dry basis), std. cu. ft.		190
Composition of injected air:	Component	Volume %
	N_2	79.0
	O_2	21.0
Composition of produced gas:	Component	Volume %
	N_2	84.2
	O_2	1.1
	CO_2	11.7
	CO	3.0

Field data

Pattern area, acres	5
Distance between injection and producing wells, ft.	330
Formation thickness, ft.	30
Formation temperature, °F.	85
Production-well bottom-hole pressure, psia.	14.7
Porosity, %	35
Specific permeability, md.	500
Oil saturation, %	55
Water saturation, %	40
Volumetric sweep of burned zone, %	30
Production-well radius, ft.	0.276

From the above information, calculate the following:

1. Volume of nitrogen and oxygen injected, laboratory run.
2. Volume of nitrogen, carbon dioxide, carbon monoxide, and oxygen produced, laboratory run.
3. Weight of carbon and hydrogen burned and weight of water formed by combustion, laboratory run.
4. Weight of total fuel consumed, laboratory run.
5. Fuel consumed per cu. ft. of sand pack burned.
6. Fuel consumed per acre-ft. of reservoir burned.
7. Air injected per acre-ft. of reservoir burned.
8. Air injected per acre-ft. of pattern.
9. Total air needed for five-spot pattern in the field.
10. Air flux for a rate of burning-front advance of 0.125 ft. per day.
11. Maximum air rate for field pattern.
12. Time required to reach maximum air rate.
13. Volume of air injected while reaching maximum rate.
14. Volume of air injected during constant-rate period.
15. Duration of the constant-rate period and total time for entire burning operation.
16. Maximum air-injection pressure required (assume $\mu = 0.0186$ cp.).
17. Compressor-plant horsepower required for an operating sequence of four patterns, assuming three stages of compression and a compressor horsepower requirement of 80/M.M. s.c.f.d./stage.
18. Oil displaced from the reservoir burned, oil displaced from the unburned reservoir, total oil recovery, and over-all oil-recovery efficiency.
19. Water produced per acre-ft. of reservoir.
20. Oil recovered per M.M.s.c.f. of air injected.
21. Maximum oil production rate from the field pattern.
22. Water produced per M.M.s.c.f. of air injected.
23. Maximum water production rate from the field pattern.

Nomenclature and Units

A = air required/cu. ft. of reservoir burned (s.c.f./cu. ft.).
a = distance between injection well and producing well (ft.).
CO_{2g} = carbon dioxide in produced gas (vol. %).
CO_g = carbon monoxide in produced gas (vol. %).
D = i.d. of combustion tube (ft.).
E_A = areal sweep efficiency of burned zone (%).
E_I = over-all vertical sweep or invasion efficiency of burned zone (%).
E_R = over-all oil-recovery efficiency (%).
E_V = volumetric sweep efficiency of burned zone (%).
F = porosity factor

$$= \left(\frac{100 - \phi_R}{100 - \phi_P}\right)$$

to correct for different densities of combustion sand pack and reservoir, dimensionless.
h = formation thickness (ft.).
i_a = maximum pattern air injection rate (s.c.f./day).
i_n = dimensionless flow term.
i_1 = pattern air-injection rate during increasing-rate period (s.c.f./day).
k_g = effective gas permeability (md.).
L = length of pack burned (ft.).
N_1 = oil displaced/acre-ft. of reservoir burned (bbl./acre-ft.).
N_2 = oil displaced/acre-ft. of unburned reservoir (bbl./acre-ft.).
N_3 = total oil recovered/acre-ft. of reservoir (bbl./acre-ft.).
N_{2a} = nitrogen in injected air (%).
N_{2g} = nitrogen in produced gas (%).
O_{2a} = oxygen in injected air (%).
O_{2g} = oxygen in produced gas (%).
P_{tw} = injection-well downhole pressure (psi.).
P_w = production-well downhole pressure (psi.).
P_{twf} = fictitious injection-well pressure (in absence of burned zone) (psi.).
P_r = formation pressure at radial position of burning front (psi.).
r_f = radial distance to burning zone (ft.).
r_w = production well radius (ft.).
r_1 = radial distance to burning zone at end of increasing-rate period (ft.).
S_o = oil saturation (% of pore space).
S_w = water saturation (% of pore space).
T_f = duration of increasing-rate period (days).
t_2 = duration of constant-rate period (days).
t_3 = duration of declining-rate period (days).
t_t = total time to burn one pattern (days).
u = air flux (s.c.f./day-sq. ft. of burning-front area).
u_{min} = minimum air flux required to sustain combustion (s.c.f./day-sq. ft. of burning-front area).
u_1 = air flux during increasing-rate period (s.c.f./day-sq. ft. of burning-front area.
v = rate of burning-zone advance (ft./day).
v_1 = rate of burning-zone advance during increasing-rate period (ft./day).
v_{min} = minimum rate of burning zone advance required to sustain combustion (ft./day).
A_a = volume of injected air in laboratory tube run (s.c.f.).
V_g = volume of produced gas in laboratory tube run (s.c.f.).
V_1 = volume of air injected per pattern during increasing-rate period (M.M.s.c.f.).
V_2 = volume of air injected per pattern during constant-rate period (M.M.s.c.f.).
V_3 = volume of air injected per pattern during declining-rate period (M.M.s.c.f.).
V_T = total volume of air required per pattern (M.M.s.c.f.).
W= unit fuel consumption in combustion tube run (lb./cu. ft.).
W_c = carbon in fuel burned (lb.).
W_H = hydrogen in fuel burned (lb.).
W_F = total fuel consumption in combustion tube run (lb.).
ϕ_P = porosity of sand pack (%).
ϕ_R = porosity of reservoir (%).
μ_a = viscosity of air (cp.).

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Appendix A

The injection pressure-rate relationship during combustion is derived below for a developed five-spot pattern. Similar relationships can be obtained for other well patterns by application of the same method to interference flow-capacity equations for the type of well development selected (and for a mobility ratio of unity). In addition to the usual limitations on these relationships we assume:

1. Burning front is radial.
2. Resistance to gas flow behind the burning zone is negligible compared to flow resistance ahead of the zone.
3. Gas mobility ahead of the burning zone is constant.
4. Gas shrinkage as a result of combustion is negligible.

Derivation is based on the fact that as long as flow is radial at the burning zone the flow distribution ahead of the zone is the same as would prevail in the absence of the burned-out region. Therefore, the pressure (P_r) at the radial location of the burning zone (r_f) resulting from injection at a given rate can be calculated as the pressure which would occur at r_f in the absence of the burned-out region and with injection from the well radius (r_w) at the same rate.

Since flow is assumed radial from r_w to r_f,

$$P_{twf}^2 - P_r^2 = (i_a \mu_a T_f / 0.703\, k_g h)(\ln r_f / r_w) \qquad \text{(B-1)}$$

Also, for the five-spot development with 1:1 mobility ratio (e.g., from M. Muskat's Physical Principles of Oil Production, pp. 688 and 715),

$$P_{twf}^2 - P_w^2 = (i_a \mu_a T_f / 0.703\, k_g h)[2 \ln (a/r_w) - 1.238] \qquad \text{(B-2)}$$

Subtracting Equation B-1 from Equation B-2,

$$P_r^2 - P_w^2 = (i_a \mu_a T_f / 0.703\, k_g h)[2 \ln (a/r_w) - 1.238 - \ln (r_f/r_w)]$$

Combining the logarithmetic terms and noting the assumption that $P_r = p_{tw}$,

$$P_{tw}^2 - P_w^2 = (i_a \mu_a T_f / 0.703\, k_g h)[\ln (a^2/r_w r_f) - 1.238] \qquad \text{(B-3)}$$

or in terms of the time required for the burning zone to move outward to r_f at a velocity v_1,

$$P_{tw}^2 - P_w^2 = (i_a \mu_a T_f / 0.703\, k_g h)[\ln (a^2/r_w v_1 t) - 1.238] \qquad (29)$$

Despite the assumption of a radial burning zone this relationship has been found to agree with potentiometric model data well beyond the period of radial burning. For example, when the areal sweep is 40% of the pattern area the burned zone is far from radial; however, values of P_{tw} calculated from the above equation are less than 2% higher than predicted for this areal sweep by model data for infinite mobility ratio.

Appendix B

Answers to Example Problem on In Situ Combustion

1. Nitrogen injected
   = (190) (84.2)/100 = 160.0 s.c.f.
   Oxygen injected
   = (190) (84.2)/100
   (21.0/79.0) = 42.5 s.c.f.

2. Nitrogen produced
$= (190)(84.2)/100 = 160.0$ s.c.f.
Carbon dioxide produced
$= (190)(11.7)/100 = 22.2$ s.c.f.
Carbon monoxide produced
$= (190)(3.0)/100 = 5.70$ s.c.f.
Unreacted oxygen produced
$= (190)(1.1)/100 = 2.09$ s.c.f.

3. Carbon in fuel burned
$= (22.2 + 5.70)\,12/379 = 0.883$ lb.
Water formed by combustion
$= 2(42.5 - 2.09 - 22.2 - 5.70/2)\,18/379 = 1.46$ lb.
Hydrogen in fuel burned
$= 2(42.5 - 2.09 - 22.2) = (190)(1.1)/100 = 2.09$ s.c.f.

4. Total fuel consumed
$= 0.883 + 0.162 = 1.045$ lb.

5. Fuel consumed per cu. ft. of sand pack burned
$= 4(1.045)/6\pi(1/3)^2 = 2.00$ lb./cu. ft.

6. Fuel consumed per acre-ft. of reservoir burned
$= (43{,}560)(2.00)(100-35)/(100-35)$
$= 87{,}120$ lb./acre-ft.

7. Total air injected in sand pack
$= (190 \times 84.2/100) + (190 \times 84.2/100) \times (21.0/79.0) = 202.5$ s.c.f.
Air injected/lb. of fuel consumed
$= 202.5/1.045 = 194$ s.c.f./lb.
Air injected/cu. ft. of reservoir burned
$= (194)(2.00)(100-35)/(100-35) = 388$ s.c.f./cu. ft.
Air injected/acre-ft. reservoir burned
$= (388)(43{,}560)(10^{-6}) = 16.88$ M.M.s.c.f./acre-ft.

8. Air injected/acre-ft. of pattern
$= (0.626)(16.88) = 10.55$ M.M.s.c.f./acre-ft.

9. Total air required for five-spot pattern
$= (0.626)(388)(2)(330)^2(30)/10^6 = 1{,}580$ M.M.s.c.f.

10. Air flux for a rate of burning front advance of 0.125 ft./day
$= (388)(0.125) = 48.5$ s.c.f./sq. ft.-day

11. Maximum air rate for field pattern
$= (4.77)(48.5)(330)(30)(10^{-6}) = 2.29$ M.M.s.c.f.d.

12. Time required to reach maximum air rate
$= (2.29)(10^6)/2\pi(30)(388)(0.5)^2 = 125$ days

13. Volume of air injected while reaching maximum rate
$= (125)(2.29)/2 = 143$ M.M.s.c.f.

14. Volume of air injected during constant rate period
$= 1{,}580 - 2(143) = 1{,}294$ M.M.s.c.f.

15. Duration of constant rate period
$= 1{,}294/2.29 = 566$ days
Total time for entire burning operation
$= 566 + 2(125) = 816$ days

16. Maximum air-injection pressure

$$P_{iw}^2 = (14.7)^2 + \frac{(2.29)(10^6)(0.0186)(460+85)}{(0.703)(25)(30)}\left[\ln\frac{(330)^2}{(0.276)(0.5)(125)} - 1.238\right]$$

$= 216 + 331{,}000 = 331{,}216$
$P_{iw} = 575$ psia.

17. Compressor horsepower requirement for four-pattern sequence
$= 4(2.29)(3)(88^*) = 2{,}420$ b.hp.

18. Oil displaced/acre-ft. of reservoir burned
$= 43{,}560\,[(55)(35)/(5.61)(10^4) - 2.00/350]$
$= 43{,}560\,(0.0343 - 0.0057)$
$= 43{,}560\,(0.0286)$
$= 1{,}248$ bbl./acre-ft.
Oil displaced/acre-ft. of unburned reservoir
$= (43{,}560)\dfrac{(0.40)(55)(35)}{(5.61)(10^4)}$
$= 598$ bbl./acre-ft.
Total oil recovery
$= \dfrac{(30)}{(100)} \times (1{,}248) + \dfrac{(100-30)}{100} \times (598)$
$= 374 + 419 = 793$ bbl./acre-ft.

*Compressor horsepower per M.M.s.c.f.d per stage, from charts based on 85% over-all efficiency and 5-psi. pressure drop across interstage coolers.

Over-all oil-recovery efficiency
$= \dfrac{(793)(5.61)(10^4)}{43{,}560\,(55)(35)} = 53\%$

19. Bbl. water produced/acre-ft.
$= \dfrac{43{,}560\,(30)}{(100)} \times \left[\dfrac{4\,(1.46)}{(6)(350)\pi(1/3)^2} + \dfrac{(40)(35)}{5.61\,(10^4)}\right]$
$= 13{,}080\,(0.0080 + 0.0250)$
$= 431$ bbl./acre-ft.

20. Oil recovered per M.M.s.c.f. of air injected
$= 793/10.55 = 75.2$ bbl./M.M.s.c.f.

21. Maximum oil-production rate from the pattern
$= (75.2)(2.29) = 172$ bbl./day.

22. Bbl. water produced/M.M.s.c.f. of air injected
$= 431/10.55 = 40.8$ bbl./M.M.s.c.f.

23. Maximum water-production rate
$= (40.8)(2.29) = 93.5$ bbl./day.

DX Sunray tests foam depressants in delayed cokers

Finds silicone oil best for over-all economy

BY WILLIAM D. TRAMMELL
General Electric Co.
and
DAVE GLASER
DX Sunray Oil Co.

TWO TYPES of silicones are available to suppress foam in delayed cokers. One is a compounded silicone antifoam and the other is a straight dimethyl oil. Silicone oil is the best for all around economy.

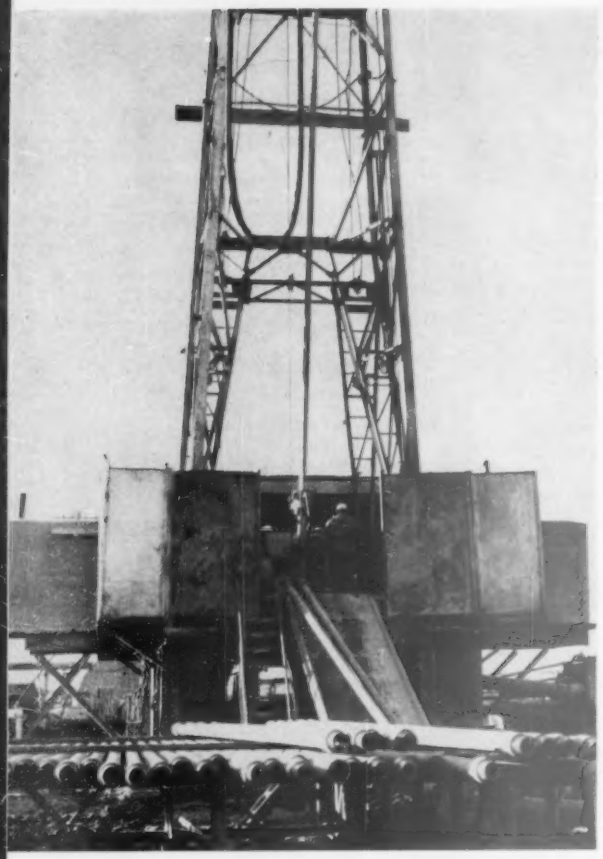
Compounded antifoams are dispersions of silica filler in a low-viscosity silicone fluid. The dimethyl silicone oils are high-viscosity long-chain polymers of silicone-to-oxygen bonds with two methyl groups attached to each carbon atom.

The following data were generated from tests run at DX Sunray Oil Co.'s 11,000-bbl. delayed coker at Duncan, Okla.:

Defoamer type—	Concentration	Defoamed 30 minutes	Antifoam unit cost— $/day	$/gal.
Dimethyl silicone oil (12,500 centistokes)	5 p.p.m.	Yes	22.40	23.40
Compounded silicone antifoam	5 p.p.m.	Yes	38.00	39.23

These data show that costs could be cut from $39 to $23 per day by switching from a compounded silicone to a dimethyl silicone oil. In some locations, the cost of compounded silicone has been as high as $1.70 per barrel per stream day. Considering that most refineries producing delayed coke charge about 10,000 bbl. per stream day, the savings becomes commercially significant.

In this test a gamma-ray detector was used to "watch" the foam level of each coking drum. Three points about 9 ft. apart are reported by this detector. When foam reached the midpoint, the test was started and the foam dropped below that point. Defoaming time was measured as the period before the foam again reached the midpoint. Any defoamer which held the foam down for 30 minutes was considered successful. More than one competitive material was used, and the results shown are typical of all materials tested. Silicones are applied to cokers in two ways. In either case they are usually cut with a low-viscosity hydrocarbon for ease in handling. After cutting, they are injected into the feed stream or dumped into the top of the coking drum. Injection into the feed stream not only retards foam, but also allows easier removal of the coke. However, the method used for this test was addition at the top of the drum.



FEW DRILLING PROBLEMS beset drillers in Tierra del Fuego. Formation lies at medium depth (7,000 ft.), pressures are normal, and a native mud is satisfactory for most of the hole. There have been few dual completions and no artificial lift thus far.

ONLY IMPORTANT LAND MASS south of the isle of Tierra del Fuego is Antarctica itself. The island is divided north and south by Chile and Argentina. Port of Ushuaia is world's southernmost and has been used as transshipping point for all goods destined for oil field farther north.

Drilling's no problem in Tierra del Fuego

—but transportation problems are a headache in this southernmost windswept oil province

BY ED McGHEE
Drilling Editor

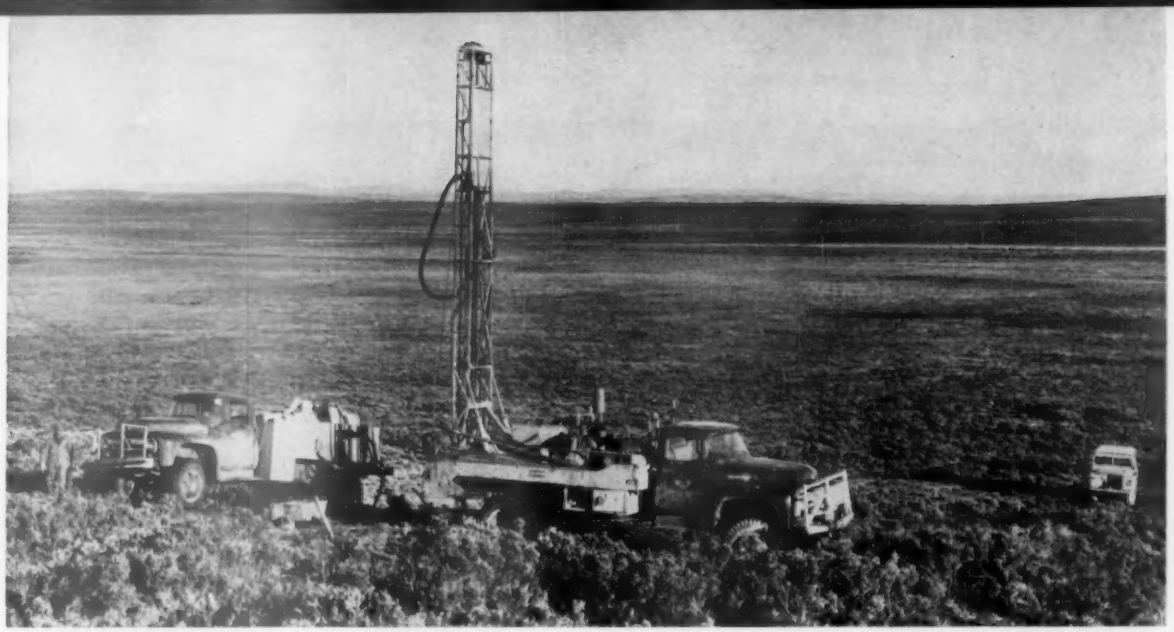
FOR OIL MEN, La Isla Grande de Tierra del Fuego has a distinction that it probably will keep forever. This windswept island delivers crude oil and gas from the lowest of southern latitudes so far developed. Only important land mass farther south is Antarctica itself.

While Tierra del Fuego's relative position in oil geography has little more than passing interest, its substantial and increasing production has important consequences. For one, the island's new wells, along with others on the mainland, are helping the Argentine Republic toward self-sufficiency in oil for the first time in that nation's history.

With full-scale development only 1½ years old, Tierra del Fuego is already adding as much as 20,000 bbl. of crude daily to Argentine production. Moreover, four rigs have been drilling continuously and have regularly increased productive capacity. The 64 wells capable of production at the end of 1960 have a maximum-efficient-recovery rate higher than present facilities can carry to market. When transportation facilities are brought up to producing capacity, there should be a big jump in daily crude movements.

Another important consequence of the Argentine production is the encouragement it gives Chile in further exploration of its side of the island.

The Argentine work is being done under a development contract let by Yacimientos Petroliferos Fiscales (YPF), the government oil agency. Tennessee Argentina, S.A., (Tennarg) a subsidiary of Tenneco Corp. of Houston, operates the



WINDSWEPT LANDSCAPE of Tierra del Fuego has not been serious obstacle to operations. Here Tennarg seismograph crew finds solid footage. Winds dry out ground quickly so mud doesn't last long. Company-built roads in the area aren't as expensive as in many other remote areas.

3,435,000-acre block where all drilling is being done. Tenneco Corp. is a subsidiary of Tennessee Gas Transmission Co. and owns its nonpipeline interests.

A good start. When Tennarg received its contract in mid-1959, there had been for some 16 years a small volume (now built up to about 19,000 bbl. per day) of production in Chilean territory. YPF had been active on the island and had three rigs at work at the time. In all, there were 17 wells, some since abandoned, at various stages of completion in Argentine Tierra del Fuego. Included were two gas wells which provided fuel for local consumption and for use in the nearby town of Rio Grande.

In spite of this history of oil, relatively little was known geologically about the area and its prospects for yielding commercially large volumes. Tennarg immediately put a seismograph party into the field and retained the contract rig which had been exploring for YPF. In addition, two more rigs which had been in shipment were put to work immediately after they arrived. Since that time, a fourth rig has joined the force.

Two of the rigs have been working in the La Sara area, by now the island's biggest proved reserve and the only major field connected to pipeline. The field is long and narrow with the northern limit not yet established. Pay is a marine beach-type sand which is also productive in other nearby fields. One of these is Arroyo Gama field which contributes about 5% of present production.

Tennarg has carried on an active wildcat program but has covered only a small portion of the 3½-million-acre contract area.

By the first of 1961, the com-

TOWN OF RIO GRANDE is only important settlement near Tennarg operations. Many of the company employes find accommodations here; the company camp on the outskirts of town houses the remainder. The company has a smaller camp in the field near La Sara.

SAN SEBASTIAN TERMINAL is owned by YPF, the Argentine oil agency, but is operated by Tennarg. Limited storage facilities here have been one factor limiting production to date. Foul weather prevents tankers from coming in for loading; storage soon fills up and wells must be shut in.

pany had brought in 47 wells of its own and had drilled a number of dry holes.

During the days of maximum production, it took only 25 wells to make 20,300 bbl. Thirty-nine oil wells are now connected and 22 are productive but not connected.

Production stepup coming. YPF, under terms of its contract with Tennarg, takes title to all oil. The crude is moved by tanker 1,500 miles north to the Buenos Aires area where it is refined for consumption inside the country.

Actually, the Tierra del Fuego crude is a premium oil for YPF. It is waxy, and sweet, and has an API gravity of 41°. It yields larger cuts of lube-oil and gasoline fractions than do the heavier crudes from the country's main producing area, Comodoro Rivadavia.

For that reason, YPF has plans under way to increase its take from the island. Much of the trouble arises from the weather. Winds are almost always strong and often exceed 80 m.p.h. A 60-m.p.h. wind is a frequent occurrence. As a result, the tankers must sometimes lay by off the island for several days before they can be brought in and loaded. In the meantime, storage on the island fills up and the wells must be shut in.

Deliveries of crude oil did not begin until August 1960. From that time until the end of the year, Tennarg and YPF had managed to move 1,619,044 bbl. Both expect that the 1961 total will be much higher.

No nearby port. Without doubt, the biggest single problem in developing the Tierra del Fuego oil is getting supplies and equipment into the area. The city of Ushuaia is the island's only deepwater port. On the remainder of the island, relatively shallow water and extremely high tides prevent ocean-going vessels from landing supplies directly. As a result, Tennarg's goods must be sent first to Ushuaia (8,450 miles from Houston, Tennessee's home office) and then transshipped to the seacoast town of Rio Grande.

Smaller, flat-bottomed craft carry the transshipped cargo; these vessels can be run close to shore and tied up at high tide. When the tide goes out, the vessel rests on the sand of what had before been the bottom of the Atlantic Ocean but what at low tide is an extremely wide beach. Cargo then can be unloaded directly onto trucks which carry it to Tennarg's warehouse outside Rio Grande.

To speed and ease the process, Tennarg has delivered to the island three large barges and a tugboat. The barges will be towed out from the island to lighter off cargo from ocean-going ships. They can then be brought back by tug for low-tide unloading. Docks for this operation are now under construction.

The island of Tierra del Fuego itself offers almost nothing in the way of local produce which would support an oil-development campaign. The high winds and low temperatures make agricultural production virtually impossible. Principal industry is sheep raising on big ranches called estancias. So, almost everything has to be shipped in.

Unhappily, there is on neither side of the South American Continent an important source of supply for anything, closer than Buenos Aires, a distance of 1,500 miles. As a result, there is long delay in getting cargo delivered in the oil fields. While air deliveries ease the worst emergencies, there is still a monumental problem. The situation is so bad that Tennarg is even constructing its own oxygen plant for the island. At present, oxygen must be brought at great expense from Buenos Aires and supply is too spasmodic to support continuous operation.

Already Tennarg has installed its own packaged "refinery." This unit distills about 200 bbl. per day of crude and supplies fuel and products for use in the company's operations.

Fortunately, YPF had already completed a gas-supply well. This well—in what is now called Rio

CONTRACT RIG owned by Laughlin-Porter Drilling Co. works for Tennarg. This location is in La Sara field which is the major reserve found to date and which produces most oil. As many as four rigs have been at work, some on development wells, others on wildcats.

Chico field—is 50 km. from the La Sara development, but a pipeline has been laid and gas is used to run three of the four rigs. The fourth rig is a diesel-electric; until now, fuel for it has been purchased but henceforth the new company "refinery" will supply the needed fuel.

Gas from the Rio Chico well is also used in Tennarg's installations at Rio Grande.

Weather not big problem. Once the men and equipment are on the island, the weather is seldom a problem to them. In spite of the extreme latitude of the contract area, it isn't as cold as much of the surrounding area—even some places much farther south. A low range of mountains splits the island from east to west and shields the oil area above from the worst of the Antarctic-born weather.

The temperature does get low in winter (25° F. is common) and never gets very high in the summer (seldom above 70° F.) Still outdoor work is rarely halted. Rain seldom interferes; the winds dry the ground quickly. And, since the terrain isn't too rugged, the Tennarg-constructed oil-field roads are not a great expense compared to other areas in the oil world.

There are some 650 persons engaged in Tennarg's operations on the island; this includes a large number working directly for Laughlin-Porter Drilling Co. which owns and operates the drilling rigs. A number of other people work in Tennarg headquarters in Buenos Aires.

While the company has built a camp and warehouse at Rio Grande, it isn't necessary to house all employes. The town itself is large enough that some of the employes find suitable accommodations for their families and don't have to live in remote areas.

Tennarg counts itself fortunate that it has found a capable and willing work force in Argentina. Graduate engineers and other professional men have been employed and, after becoming familiar with oil operations, make it possible to operate with a minimum expatriate force.

Few drilling problems. Tierra del Fuego's formations thus far have proved fairly easy to drill. One of the rigs can spud a well, drill to 7,000 ft., complete, move on location, and spud another well in an average of 19 days. In drilling, there has been no major loss of circulation, no crooked-hole problem, no expensive muds, and no especially hard formations. In completing, there have been no logging problems, few multiple completions, no casing problems, no cement problems, and no stimulation.

In producing, thus far there have been no artificial lift, no corrosion, no excess water, no sanding problem, and no high gas-oil ratios. Time, of course, will likely change these conditions.

The formation which produces at La Sara and several other places is called the "Springhill" sand and it generally lies between 6,800 and 7,000 ft. Some wells have as much as 250 ft. of clean, porous, and permeable sand. Bottom-hole pressure is normal for the depth. Development is on a 35-acre spacing.

Bottom-water has been found in a few wells but it's uncertain whether or not the field is blessed with a strong water drive. No primary gas cap has been found.

Usually, the holes are spudded with a 12¼-in. bit and drilled to 600 ft. where 9⅝-in. surface casing is set. Then, an 8⅝-in. hole is drilled to total depth around 7,000 ft. For most of the long hole, a native mud is sufficient. Deeper, a small amount of starch, caustic, and quebracho are added.

After the hole is logged, 5½-in. casing is run to total depth and cemented high enough to protect the pay formation. The 2-in. tubing string has at times been run before the well is perforated; at other times it is run after perforation. To put the well on production, it is necessary only to wash it in with oil.

The 2-in. tubing is set on packer for production. On wells which are dually completed, the higher zone flows out through the casing-tubing annulus.

The La Sara wells flow on fixed chokes into four batteries. Since producing gas-oil ratio is only about 500 cu. ft. per bbl., there is little gas to handle. However, the company has purchased three packaged gas compressors which will soon begin reinjecting the gas to maintain reservoir pressure.

While paraffin has not yet been a problem, Tennarg thinks it may become one. The crude has a pour point above the ambient temperature, so provisions are being made to clear out lines and equipment if ever paraffin deposits clog them.

Into terminal. La Sara is capable of producing all the oil which can be transported with present facilities and is only 5 miles away from the shipping terminal on San Sebastian Bay. The terminal is owned by YPF but operated by Tennarg.

Oil from the terminal is moved by a 3-mile submarine pipeline out to waiting tankers in the bay.

Questions on
TECHNOLOGY

Breakeven cost of operating tankers

BY W. L. NELSON
Technical Editor and Petroleum Consultant

What is the breakeven cost of operating tankers? Everyone speaks of it as being important but I cannot find specific values. R. T. S.

The breakeven cost of operation is obviously vital to each tanker operator because when such a tanker rate is encountered there is no profit. At lower tanker rates, the operator is faced with the difficult problem of whether to operate at a loss and for how long, whether to take the vessel temporarily out of service, or whether to sell the vessel for its scrap value. Trouble arises in stating operating costs (or breakeven rates) because each vessel has its own environment. How efficient or old is it? Is it paid for, or must the investment be regained? Is it registered under a flag foreign to the U. S. (which permits lower wages for seamen)? Will its charter soon expire? There is no end to the variations that will be encountered and accordingly nearly every breakeven rate that is mentioned fails to confirm or agree with other breakeven rates.

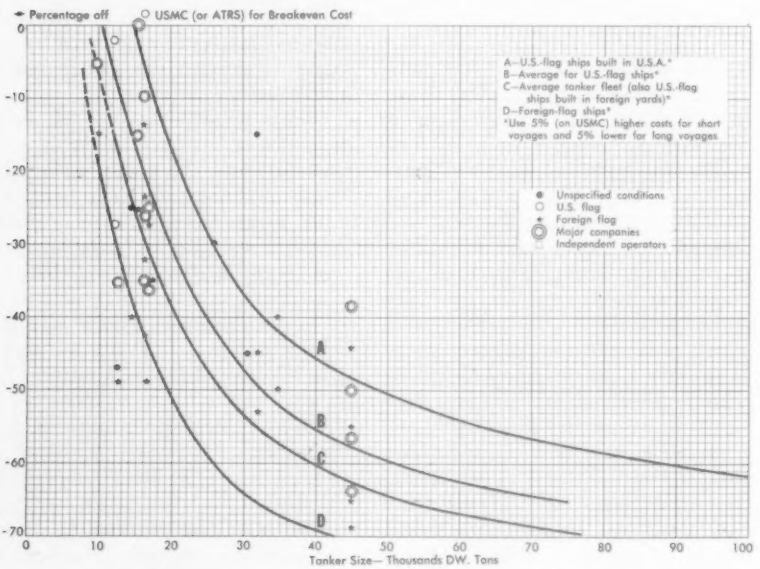
Table 1 indicates hints or statements in the literature concerning breakeven rates and these have been plotted in Fig. 1. The literature was so unsatisfactory that the author computed the sixteen following rates (1956 costs):

Route	Flag	Built	% off USMC
	T-2 16,600 Dw. Tons		
NWI/USNH	foreign	foreign	—32
NWI/USNH	U. S.	foreign	—26
NWI/USNH	foreign	U. S.	—13.5
NWI/USNH	U. S.	U. S.	+ 3
PG/USNH	foreign	foreign	—49
PG/USNH	U. S.	foreign	—35
PG/USNH	foreign	U. S.	—23.5
PG/USNH	U. S.	U. S.	— 9.5
	45,000-Dw. Ton Supertanker		
NWI/USNH	foreign	foreign	—63
NWI/USNH	U. S.	foreign	—56.5
NWI/USNH	foreign	U. S.	—44.5
NWI/USNH	U. S.	U. S.	—38.5
PG/USNH	foreign	foreign	—69
PG/USNH	U. S.	foreign	—64
PG/USNH	foreign	U. S.	—55
PG/USNH	U. S.	U. S.	—50

TABLE 1—STATEMENTS CONCERNING BREAKEVEN COSTS

Ref.	Year	Route	Breakeven rate	Notes	Tanker size*
1	1947-48	PG/USNH	USMC-47	War Shipping Board	12,500
		PG/USNH	USMC- 2 to -27	Companies	12,500
2	1949		USMC-35	U. S. flag	12,700
			USMC-49	Foreign flag	12,700
			USMC-30		26,000
3	1954		USMC-25		14,600
4		NWI/USNH	USMC-40	Mainly foreign	14,600
		NWI/USNH	USMC-25	Mainly foreign	14,600
5	1955	Gu'f/USNH	USMC	U. S. flag-majors	15,700
		Gulf/USNH	USMC-15	U. S. flag-independent	15,700
6	1957		USMC-40	Mainly foreign	45,000
			USMC-25	Mainly foreign	29,000
			USMC- 5	Mainly foreign	16,000
		Gulf/USNH	USMC-40	U. S. flag	35,000
		Gulf/USNH	USMC-25	U. S. flag	17,000
		Gulf/USNH	USMC- 5	U. S. flag	10,000
		NWI/USNH	USMC-50	Foreign flag	35,000
		NWI/USNH	USMC-27.5	Foreign flag	17,000
		NWI/USNH	USMC-15	Foreign flag	10,000
		Long voyages	USMC-35	Foreign flag	17,000
7	1958		USMC-45		30,700
8	1959		USMC-65.5		45,000
			USMC-33		16,600
9	1960	Gulf/USNH	USMC-15		32,000
		NWI/USNH	USMC-45		32,000
		PG/USNH	USMC-53		32,000

*When no size was stated the average size for the year was used.



APPROXIMATE breakeven costs (1956) for oil tankers. Fig. 1.

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How to predict

CONTAMINANT COKE YIELD

Its formation depends on

- feed properties
- catalyst residence time in reaction zone
- catalyst surface area
- metal concentration
- number of cycles of regeneration metals have undergone

BY H. R. GRANE, J. E. CONNOR, AND G. P. MASOLOGITES
Atlantic Refining Co., Philadelphia

THE CHEMISTRY of coke formation is extremely complex. Coke is not a specific compound, nor does it result from a single reaction mechanism.

There is the inherent "catalytic coke" which is formed when a hydrocarbon is cracked over an acidic catalyst.

There is "cat-to-oil coke" which results from hydrocarbons being entrapped in the pores and interstices of the catalyst as it circulates from the reactor to the regenerator. As such, it is related to circulation rate and pore volume of the catalyst and to the efficiency of stripping.

Some feed stocks contain "Conradson carbon," high-boiling compounds that deposit on the catalyst as a residue.

Paper presented at midyear meeting of API's refining division, Houston, May 11, 1961.

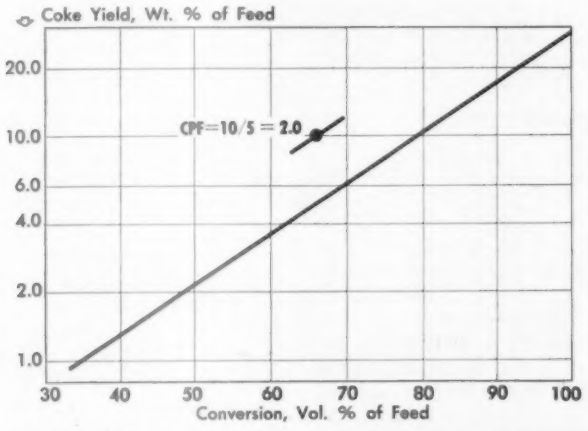
"Contaminant coke" is still another type that is formed to a substantial degree. Contaminant coke refers to that produced as a result of metal poisons on the catalyst. As a typical example, here is the total coke yield from one of Atlantic Refining Co.'s fluid catalytic cracking units:

	% of total coke
1. Catalytic coke	45
2. Cat-to-oil coke	20
3. Conradson coke	5
4. Contaminant coke	30
	100

Considering the magnitude of coke from this source, it is surprising that so little has been published in the way of quantitative relationships. It is known, of course, that metals are present in most feed stocks, and that they deposit on the catalyst as the feed is cracked. However, a completely satisfactory method has not been developed to predict the behavior of these metals.

Laboratory studies wherein the contaminants are synthetically deposited have been very informative for showing trends, but they have shown that such catalysts give a much poorer product distribution than catalysts that have been naturally contaminated to the same metals content in the cracking unit.

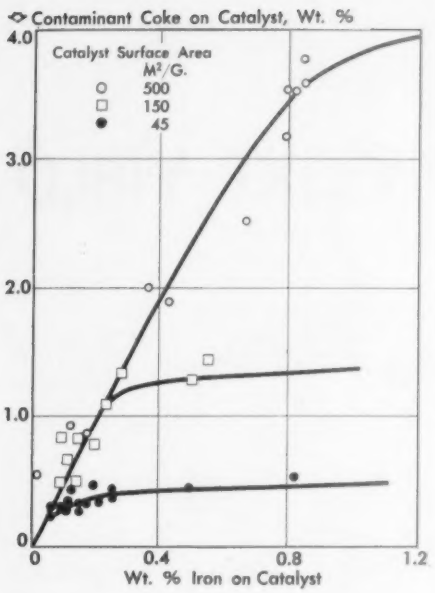
This study is part of a continuing effort to understand more fully the differences between laboratory and plant-contaminated catalysts and to develop methods for using laboratory results more effectively in predicting commercial behavior.



ATLANTIC LINE for coke-producing factor = 1.0, using furnace-oil medium feed stock. Fig. 1.

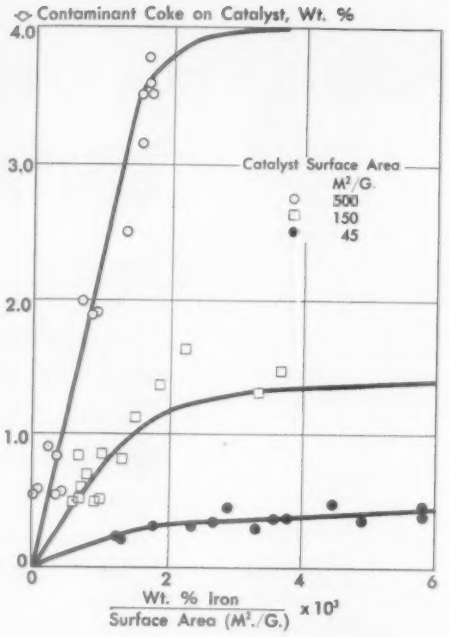
Contaminant coke. The refiner normally uses a coke-producing factor (CPF) to indicate the degree of contamination of a catalyst. The CPF is a ratio of the coke yield for a given catalyst relative to that for an uncontaminated catalyst, when operated at the same conversion level (Fig. 1).

Since the CPF expresses total-reaction coke yield as a ratio of catalytic coke, it implies that contaminant coke is directly related to catalytic coke. The metal contaminants, however, are in themselves catalysts which promote dehydrogenation reactions through mecha-



CONTAMINANT coke increases as metal concentration on the catalyst increases, until a saturation point is reached. Beyond this point, increase in metals has little effect. Fig. 2.

SATURATION point is reached at a metal concentration corresponding to a coverage of about 1% of a monolayer. Fig. 3.



nisms quite different from the silica-alumina cracking reactions. There is no reason to relate the two, and to do so can give misleading conclusions.

It has been suggested that the carbon produced by the contaminant be considered separately, unrelated to the cracking reaction. Using this assumption, we have attempted to relate quantitatively the formation of contaminant coke. We have done this by correlation methods similar to those used to predict catalytic coke for a clean catalyst.

Contaminant coke as used in this study is the difference between the actual coke yield from a contaminated catalyst and the predicted coke yield for a clean catalyst at the same conversion level. It is expressed as per cent by weight of the catalyst. Table 1 shows a typical calculation.

Many of the experimental data have been obtained in the laboratory using 13% alumina synthetic catalyst and the Atlantic D+L test.[1] A 12-minute oil-cracking period is used, charging 2 ml. per minute of oil over 200 g. of pelleted catalyst in a fixed bed of 900° F. and atmospheric pressure. The standard feed is a light fraction from East Texas crude oil boiling between 400° and 600° F., although other feeds have been used. Conversion may be varied by changing the weight of catalyst charged.

Effect of Metals and Catalyst Surface Area

Most of the discussion will be limited to synthetically deposited iron on silica-alumina catalyst. The contamination was done in the laboratory using iron naphthenate dripped onto a fluid bed, as described in previous work from this laboratory.[2,3] Test measurements were made in Atlantic's D+L equipment, with the furnace-oil feed stock.

Fig. 2 shows the contaminant coke per gram of catalyst. This was measured for various iron concentrations on three catalysts of different surface area. (Additional points have been added to those reported previously.[3])

As the concentration of metal increases on a given catalyst, the yield of contaminant coke increases until a saturation point is reached. Beyond this point, an increase in metals content has little effect.

It is interesting to note that this saturation point is at a different iron content for the three catalysts having different areas. Further, the critical concentration is essentially proportional to the surface areas. This suggests that the concentration of metal per unit of surface area, or possibly the ratio of metal surface area to silica-alumina surface area, is a significant variable.

By replotting iron concentration per unit of surface, as shown in Fig. 3, three curves are obtained. Each of these changes slope at a metal concentration corresponding to a coverage of about 1% of a monolayer. At the higher concentrations, there is only a slight increase in metal activity. Similar results have been found in developing platinum reforming catalysts.[4]

TABLE 1—CALCULATION OF CONTAMINANT COKE

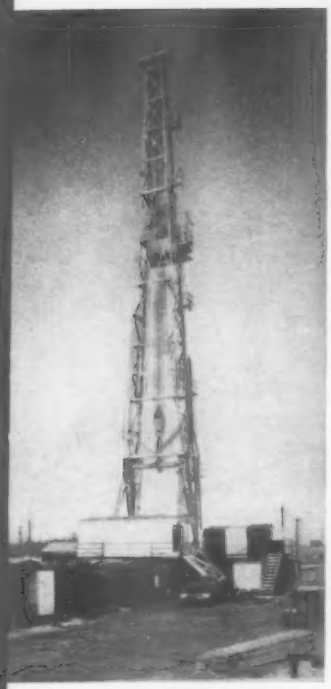
Catalyst:	40 g. of 0.09% iron on 150 sq. m. per g. silica-alumina.
Oil:	20 g. (24 ml.) 508° F. midboiling-point furnace oil medium.
Test:	Standard Atlantic 12-minute D+L test.

Conversion, as measured	31.3 vol. % of feed
Coke, as measured	0.75 wt. % of catalyst

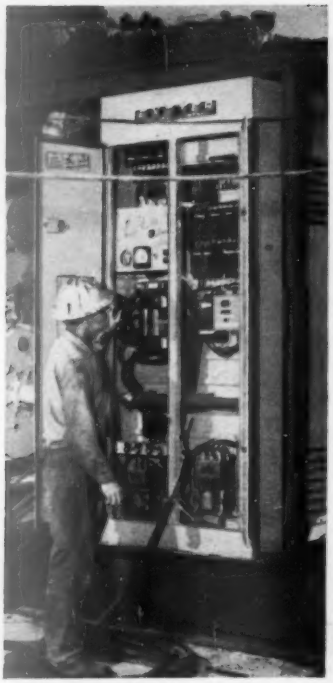
Coke yield for clean silica-alumina catalyst at 31.3* conversion
= 0.48 wt. % of feed or 0.24 wt. % of catalyst

Contaminant coke = 0.75 − 0.24 = 0.51 wt. % of catalyst

*The conversion used here should be measured conversion less any conversion resulting from contaminant effects. This refinement is significant only when catalytic and contaminant coke yields are both high.



CASCADE—First diesel-electric drilling rig operating in Canada.



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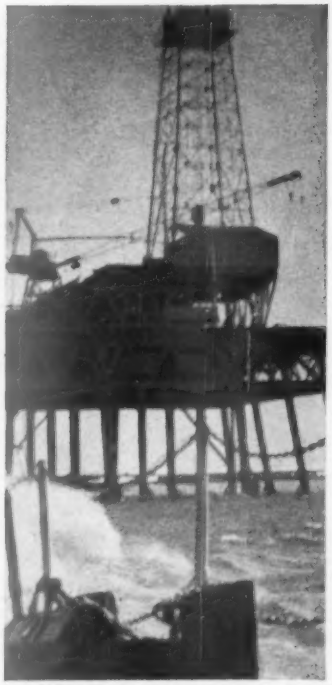

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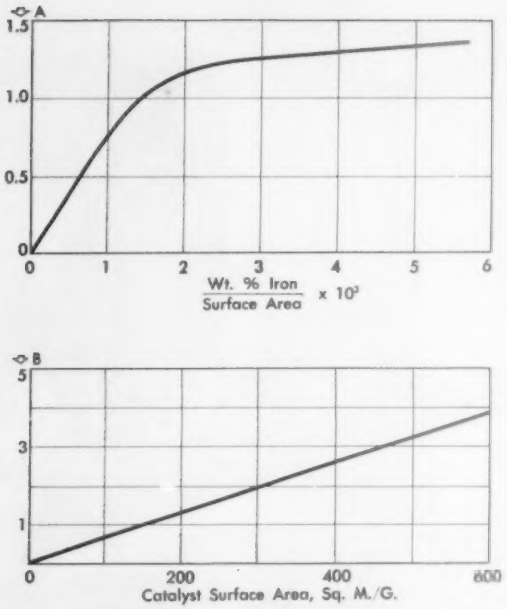
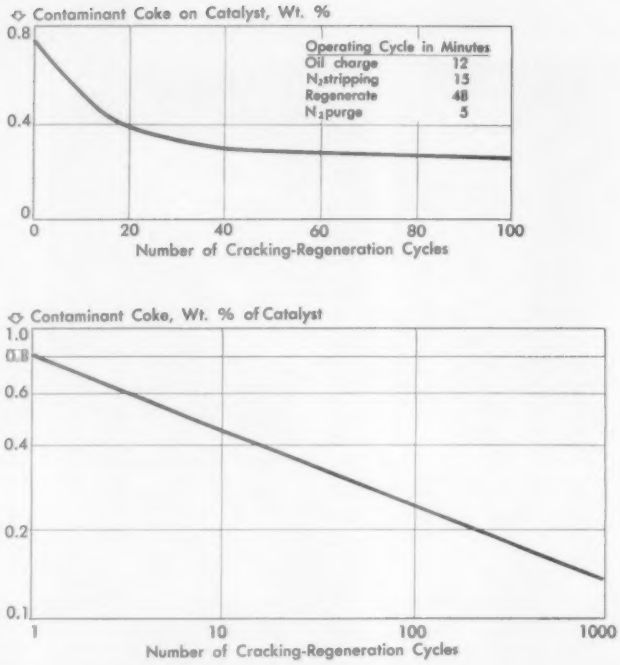


CONTAMINANT COKE YIELD equals A times B, per cent by weight of catalyst. Contaminant effect depends on the concentration of metal per unit of surface area, and on the total amount of contaminated surface. Fig. 4.



ACTIVITY OF METALS decreases after only one cracking-regeneration cycle at conditions which do not affect activity of the catalyst. After more cycles, contaminant coke continues to drop, but at a lower rate. The lower figure shows the same data plotted on a log-log scale. Fig. 5.

Another interesting observation is that at a given concentration of metal per unit surface area the contaminant coke is directly proportional to the silica-alumina surface area.

For correlation purposes, the relationship could be plotted as shown in Fig. 4, which makes it clear that the contaminated effect depends:

1. On the concentration of metal per unit of cracking surface area.

2. On the total amount of this contaminated surface available.

Other metals. Similar programs have been carried out using nickel and vanadium as the contaminating metals.

The contaminant coke obtained from vanadium was very similar to that obtained with iron in the low concentration range.

Nickel, of course, produces more contaminant coke than either iron or vanadium at a given metal concentration, but the same type of relationship is found to hold. When contaminant coke was plotted against per cent by weight nickel per unit of surface area, a graph similar to Fig. 3 was obtained. Contaminant coke is about four times as high as shown for iron.

The relationships presented for iron can be used for approximating total contaminant effect by using an "equivalent iron" concentration which is equal to iron plus vanadium plus four times the nickel concentration. A limited amount of data on mixtures of these metals indicates fair agreement with predictions made on an equivalent-iron basis. This technique should be limited to the low concentration range, below 0.002 wt. % per sq. cm.

Deactivation of Metal Contaminants

Much can be learned by studying the behavior of freshly deposited synthetic contaminants, but it is well known that commercial equilibrium catalysts containing the same metals content give substantially lower coke yields. It has been shown[3] that the structure and concentration of the contaminant in the feed stock, molecular weight of the feed stock, and method of deposition all affect catalyst performance. In addition, in the case of iron particularly, some of the metal originating from corrosion and other foreign sources is relatively inert as a contaminant and does not affect selectivity.

With all these factors considered, however, the laboratory - contaminated and plant-contaminated catalysts are still different and some other explanation must be found to relate the two.

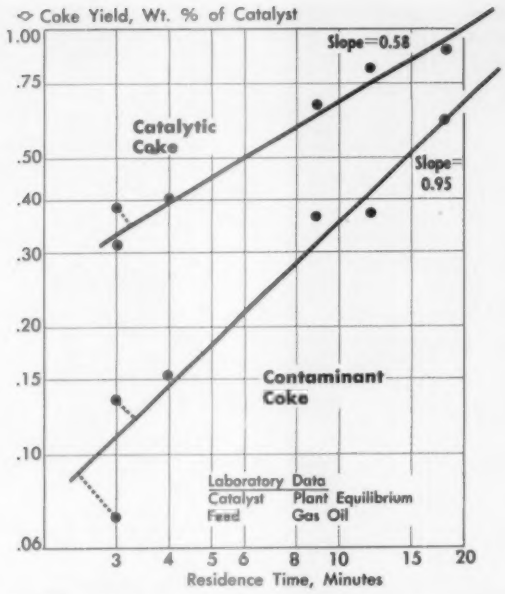
This additional factor appeared to us to be associated with physical and chemical changes that occur after the metals are deposited on the catalyst and exposed to process conditions.

The deactivation resulting from the metals being buried or becoming inaccessible from collapse of the silica - alumina structure have already been reported.[3]

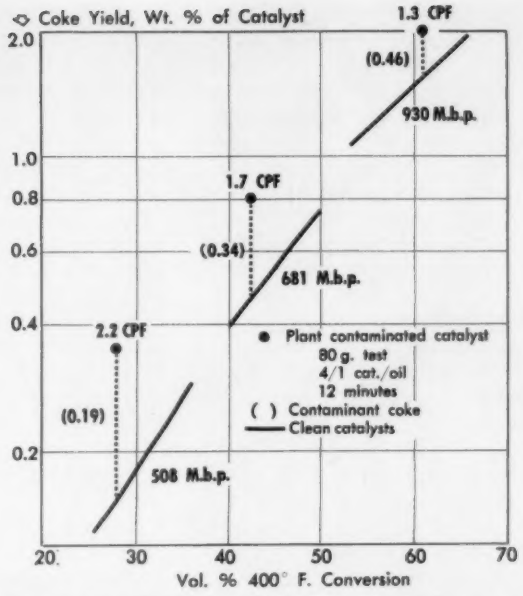
Frequent change from the oxidizing atmosphere of the regenerator to the reducing atmosphere of the reactor may well affect the oxidation state of metals, or it may cause them to be deactivated by sintering and loss of metal surface area. Analysis of samples or regenerated catalyst from our commercial unit showed that over 90% of the nonmagnetic iron was in the ferrous state.

In an attempt to get some quantitative information on the changes that occur, catalysts with freshly deposited metals were subjected to multiple cracking and regeneration cycles.

For example, a catalyst of 150



SLOPES DIFFER for catalytic coke and contaminant coke. Since this is true, the CPF must change as the catalyst residence time is varied. Fig. 6.



CONTAMINANT COKE per gram of catalyst increases as the feed gets heavier, but the CPF decreases. Fig. 7.

sq. m. per g. containing 0.2% iron was put through 100 cycles at 900° F., where each cycle was:

	Minutes
1. Oil cracking	12
2. N_2 stripping	15
3. Regeneration, 4% O_2	48
4. N_2 purge	5

Results are shown in Fig. 5. Activity of the metal decreases markedly after only one cycle at conditions which do not affect the activity of the cracking catalyst. Upon exposure to additional cycles, contaminant coke continues to drop, but at a lower rate. The same data on a logarithmic plot can be approximated by a straight line for extrapolation purposes.

When the same contaminated catalyst was exposed to a 4% oxygen stream at 900° F. steadily for 400 minutes—equivalent to 5 cycles—practically no deactivation occurred. The alternating oxidation-reduction exposure is necessary to alter the activity or surface area of the metal.

Little change in the deactivation rate shown in Fig. 5 occurred as a result of doubling the oil cracking time or increasing the boiling range or sulfur content of the oil used for cracking. This also suggests that as long as the alternating oxidizing and reducing atmosphere is imposed, the actual cracking is not important.

This fact was verified when hydrogen was substituted in place of the oil cracking and there was no significant change in the decline rate. The necessity for burning coke from the catalyst with perhaps high local temperatures was also ruled out as an important variable by this hydrogen run in which there was no coke to burn.

Doubling the length of the regeneration cycle or increasing from 4% oxygen all the way to 21% oxygen in the regeneration gas had little effect on the results.

Temperature is another variable that has little effect, since a repeat program carried out at 1,050° F. instead of 900° F. gave almost the same results.

Metal age. What is the significance of this deactivation-rate curve? It helps to explain the conflicting reports in the literature and in our own experience on the importance of contaminant age. During the early cycles of deactivation, metal age is extremely important, but after many cycles of oxidation and reduction, the effect of age is minor. It is apparent that catalyst metal content alone is of little value unless its history is also known, and that correlations based solely on metals analyses are not likely to be effective.

In both plant and pilot-plant operations, it has been observed that when changing from a highly contaminated feed to a less contaminated feed, the coke production drops fairly rapidly—more rapidly than can be accounted for by the purging of metals by fresh-catalyst additions. The rapid deactivation of those metals deposited just prior to switching to clean feed offers a satisfactory explanation for these observations.

Using the metal-deactivation curve presented and making some practical assumptions concerning the age of the metal contaminants, useful tie-ins between plant, pilot-plant, and laboratory contamination results have been achieved. We are currently attempting to measure metal dispersion in an effort to get more direct indications of metal effectiveness.

Effect of Catalyst Residence Time

It has long been recognized that laboratory testing of a catalyst can give misleading results on coke production, especially if the oil cracking period is long. For this reason, refiners have an inherent interest in catalyst tests with a short cracking period rather than those tests with 1 hour or more of continuous oil feed without regeneration.

Fig. 6 shows why catalyst resi-

dence time is important in determining a catalyst CPF. Laboratory tests were run on a typical sample of commercial equilibrium catalyst having an Atlantic CPF of 2.1. The cracking period, or the catalyst residence time, was varied from 3 to 18 minutes at constant space velocity using a gas-oil feed.

A plot of catalytic coke—the coke produced from clean silica-alumina—against residence time on log-log paper gives a straight line as shown earlier by Voorhies.[5] Similarly, the contaminant coke shows a straight-line relationship, but at a steeper slope.

Catalytic coke is proportional to residence time to the 0.58 power and contaminant coke is proportional to residence time to the 0.95 power. Since the slopes are different, the two types of coke cannot be simply related, and the CPF obviously changes as the time is varied.

Over the limited range from 3 to 18 minutes, the CPF with this gas-oil feed increases from 1.3 to 1.7. Because most commercial operations have an average residence time in the reactor of only several minutes, a short laboratory test is required if direct application is intended.

A circulating fluid cracking operation has some significant differences from a fixed-bed laboratory cracking test. In the former, the oil contacts catalyst with a constant average carbon content in the reactor, but in the latter, whether fluidized or not, the oil contacts catalyst of increasing carbon content as the run progresses. It is possible, therefore, that the residence-time effect might be different for the two types of operation. However, an analysis of pilot-plant and plant data has substantiated that contaminant coke increases more rapidly than coke as catalyst residence time is increased.

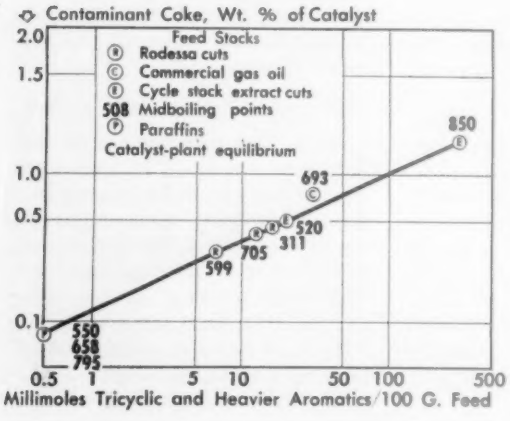
Fig. 6 would indicate that there is an advantage in operating a cracking unit at low residence time where the ratio of contaminant coke to catalytic coke is minimized. However, if the residence time is reduced by increasing catalyst circulation rate, the lower contaminant coke must be balanced against the higher cat-to-oil coke.

Effect of Feed Stock

If a given contaminated catalyst is tested for its CPF with a number of different feed stocks, different CPF's may be obtained.

It is not unlikely that, as the chemical composition of feed varies, the relative coke-producing reactions catalyzed by silica-alumina or metal poisons change. The interrelationship of contamination level and feed composition is of such a complex nature that a great deal more work must be done to gain a satisfactory understanding. We have observed that as feed boiling range or molecular structure varies, the contaminant coke yield varies, and sometimes in the opposite direction of the CPF change.

Fig. 7 shows coke yields as a function of conversion for three feed stocks when using a clean catalyst, plus three runs using a sample of plant equilibrium catalyst. The three feeds have midboiling points of 508°, 681°, and 930° F. The runs on the equilibrium catalyst were all made with the same amount of catalyst and at the same feed rate.



CHEMICAL composition of the feed stock is also an important variable. Contaminant coke increases as polycyclic aromatics in the feed increase. Fig. 8.

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The contaminant coke per gram of catalyst increases as the feed gets heavier, but the CPF decreases. The CPF, of course, depends on the relative coke yield from the metals and from the acidic silica-alumina.

The 508° F. midboiling-point stock is the charge to Atlantic's standard D+L and CPF test. It was selected because of its sensitivity to contaminants on a CPF basis. Atlantic CPF ratings are therefore higher numbers than those obtained from other laboratory tests.

Aside from boiling range, chemical composition is also an important variable.

Fig. 8 shows contaminant coke yield as a function of the tricyclic and tetracyclic aromatics in the feed. This type of feed characterization has been suggested by Abbott[6] and others in their work.

Note that contaminant coke increased markedly as polycyclic content increased. The three paraffin cuts (P) representing C_{16}, C_{20}, and C_{27} fractions yielded nil contaminant coke. In other words, a plant equilibrium catalyst makes no more coke than a clean catalyst when charging these stocks. Two cuts from a cycle-stock extract (E), three cuts from a virgin Rodessa gas oil (R), and a full-range commercial gas oil (C) were also studied.

The heavy aromatics, which are well-known coke formers, result in even greater coke yields when cracked on a contaminated catalyst. An increase in contaminant coke is clearly shown, but the specific relationship plotted is not intended as a finished correlation. These studies are still in progress.

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2. J. J. Rothrock, E. R. Birkhimer, and L. N. Leum, "Fluid Cracking Catalyst Contamination: Development of Contaminant Test": Ind. Eng. Chem. 49 (2) 272-6 (1957).

3. J. E. Connor, J. J. Rothrock, E. R. Birkhimer, and L. N. Leum, "Fluid Cracking Catalyst Contamination: Some Fundamental Aspects of Metal Contamination": ibid., 276-82.

4. Unpublished data of the Atlantic Refining Co.

5. A. Voorhies, Jr., "Carbon Formation in Catalytic Cracking": Ind. Eng. Chem. 37 (4) 318-22 (1945).

6. M. D. Abbott, R. C. Archibald, and R. W. Dorn, "Improvement of Catalytic Cracking Feed Stocks by Hydrogenation": Proc. API 38 (III) 184-92 (1958); also Pet. Refiner, 37 (5) 161-6 (1958).

Here's a quiz on heat transfer

• On this page are nine questions covering heat-transfer principles discussed in the first six parts of the series.

PLEASE PUT a check (√) mark opposite the correct answer.

1. Which exchanger lineup at right will transfer the most heat?

.... (a)
.... (b)

2. If, in either picture at right, the temperature (T-1) of the bottoms stream leaving the last exchanger should rise due to poorer heat transfer (exchanger fouling) while the tower-bottoms stream temperature at T-2 remained the same and all rates remained the same—what would happen to the temperature (T-3) of the feed stream leaving the E-3 exchanger?

.... (a) Go up.
.... (b) Go down.
.... (c) Remain the same.

3. If a condensate trap on a tank heater coil is blowing through:

.... (a) The heat transferred to the liquid in the tank is increased.
.... (b) The heat transferred to the liquid in the tank is decreased.
.... (c) The heat transferred to the liquid in the tank remains the same.

4. The purpose of using floating heads in exchangers is to:

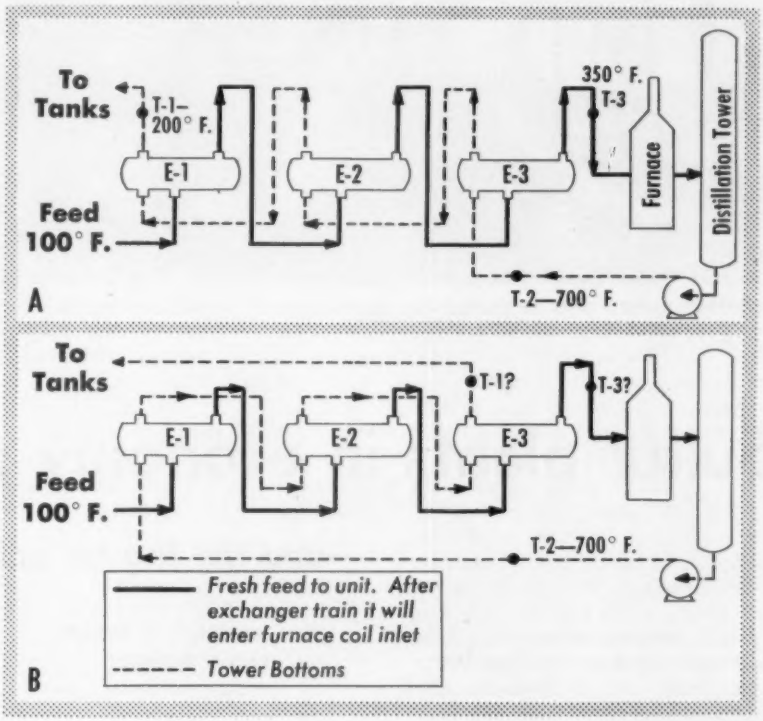
.... (a) Allow for safe thermal expansion of the tubes and shell.
.... (b) Make the tube bundle lighter because it floats.
.... (c) Make the tube bundle easy to remove.

5. Exchangers which exchange heat between two oil streams are frequently used instead of coolers and heaters because:

.... (a) They save on fuel.
.... (b) They get the oil hotter.
.... (c) They are smaller.

6. Which is the better conductor of heat?

.... (a) Copper.
.... (b) Water.
.... (c) Both the same.



7. Which can hold more heat for the same temperature increase?

.... (a) Copper.
.... (b) Water.
.... (c) Both the same.

8. Why is the F-cat regenerator metal shell lined with insulation on the **inside** instead of the **outside?** (Catalyst in regenerator is about 1,000° F.)

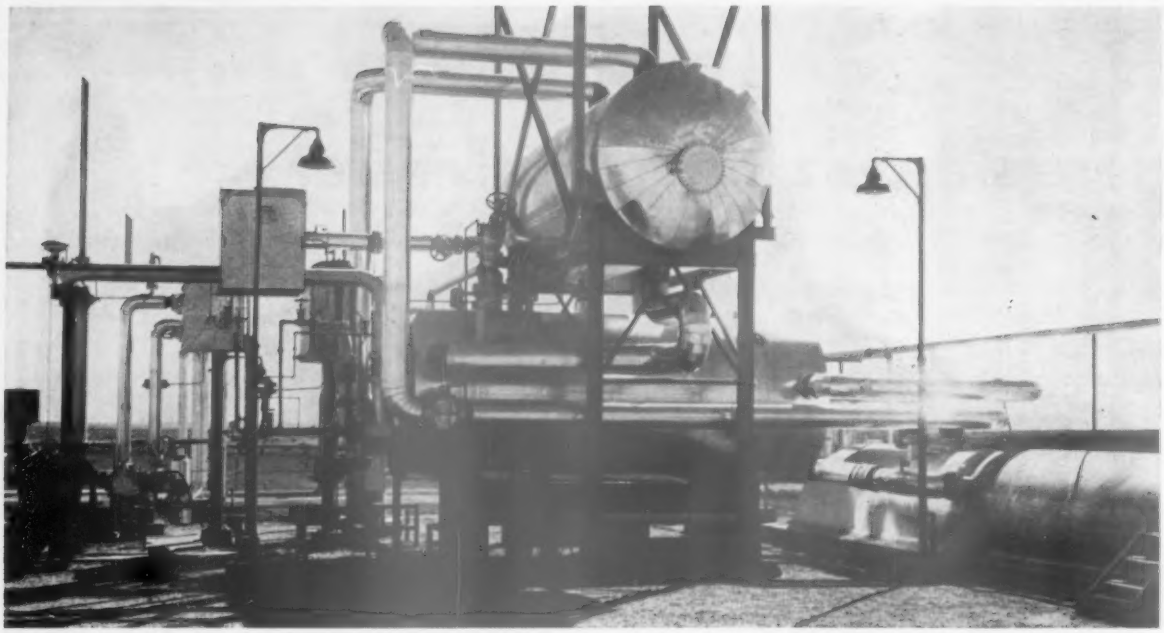
.... (a) To keep the shell cooler.
.... (b) To reduce heat loss from the regenerator.
.... (c) It is easier to put insulation on the inside.

9. What is the **most important** reason for maintaining high-velocity oil flow (turbulent flow) through a furnace tube? Check one only.

.... (a) At low velocity, heat-transfer rate will decrease causing higher furnace efficiency.
.... (b) At low velocity, heat-transfer rate will decrease causing poorer furnace efficiency.
.... (c) At low velocity, the oil will lay against the sides of the tube causing poor heat transfer and rapid tube coking.

ANSWERS TO QUIZ ON HEAT TRANSFER

1. (a) Countercurrent flow gives better heat transfer.
2. (b) Go down.
3. (b) The heat transferred to the liquid in the tank is decreased.
4. (a) Allow for safe thermal expansion of the tubes and shell.
5. (a) They save on fuel.
6. (a) Copper, $k = 228$. Water, $k = 0.36$
7. (b) Water, $Cp = 1$. Copper, $Cp = 0.09$
8. (a) To keep the shell cooler.
9. (c) At low velocity, the oil will lay against the sides of the tube causing poor transfer and rapid tube coking.



SULFUR-RECOVERY UNIT at Empire Abo gasoline plant, southeastern New Mexico. Empire Abo plant, operated by Pan Am, has processing design capacity of 20 million cubic feet of gas a day. At this rate, sulfur plant recovers 22 long tons of sulfur daily.

Sulfur plants in economy packages

—and the tag for upkeep is economical, too

BY H. GREKEL, L. V. KUNKEL, AND R. MUNGEN
Pan American Petroleum Corp.
Tulsa

EIGHT package sulfur plants have been built by Pan American Petroleum Corp. and its licensees. Operating experience to date has indicated a very low operating and maintenance cost.

Investment costs of various sized package plants are included in this roundup report.

Description. Basic features of the package plant are reviewed here to recall the advantages of the system (OGJ, Nov. 4, 1957, p. 144). The major components of the plant, shown in Fig. 1, include the air blower, the furnace-cooler-condenser, the reactors, and separator-storage drum. In the Claus-type process one-third of the hydrogen sulfide is burned to sulfur dioxide which reacts with the remaining hydrogen sulfide over bauxite catalyst under conditions which will result in the best sulfur yield. In the package unit there are five passes through the boiler. The first pass is a firing tunnel, the second is a cooling pass, the third is a cooling and sulfur-condensing pass. The fourth and fifth passes are sulfur condensers.

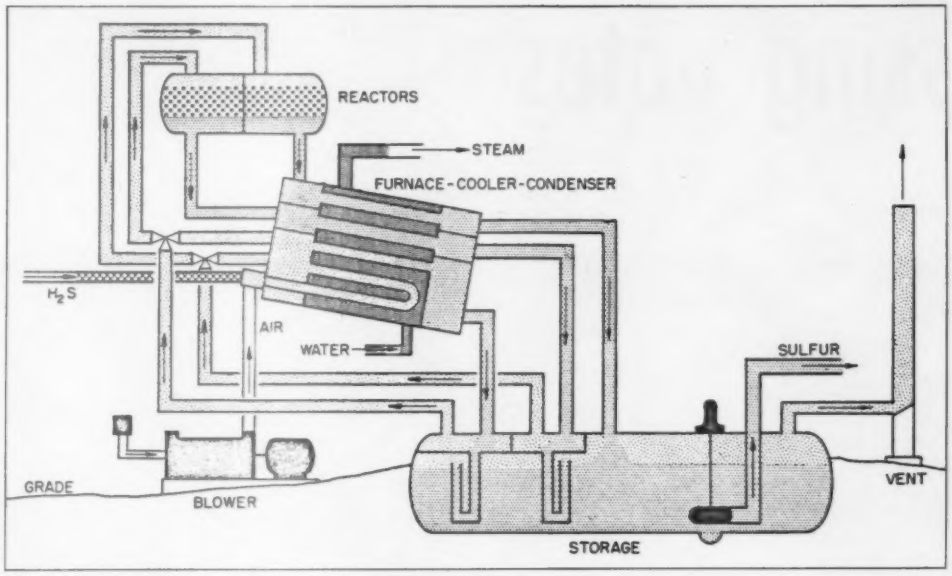
Gases from the second and third passes are blended to adjust the feed temperature to the first reactor. Second-pass gas is blended with cooled effluent from the first reactor to adjust feed temperature to the second reactor. Effluent from the reactors is cooled and sulfur condensed in the fourth and fifth tube passes in the boiler. Sulfur drains from the three condensers to storage via the separators in the storage tank.

When all of the hydrogen sulfide is passed through the firing tunnel, sulfur is produced in the furnace and that which passes through the third pass is condensed. In some situations as much as half the sulfur is produced in this manner and total recovery may be as high as 94% of the feed sulfur.

Plants have been built to process acid gas which contains light hydrocarbons, usually methane. These plants use a different flow system. The combustion of the hydrocarbons requires more air per mole than the hydrogen sulfide; therefore, a larger air blower and furnace, and larger reactors and condensers would be required if all the acid gas passed through the furnace.

However, if only a third of the acid gas passes through the boiler, only a third of the hydrocarbons are burned, and the major equipment items can be made smaller at considerable savings. The savings must be balanced against a somewhat lower yield, because little or no sulfur is produced in the furnace under these circumstances.

Presented at fifteenth annual Oklahoma state-wide AIChE meeting.



SIMPLIFIED PACKAGE sulfur plant combines all heat removal in one piece of equipment and all reaction in another single unit. Fig. 1.

Since all the sulfur is produced in the reactors, when only one-third of the feed gas passes through the furnace, the product sulfur concentration is greater and suppresses the reaction of hydrogen sulfide and sulfur dioxide.

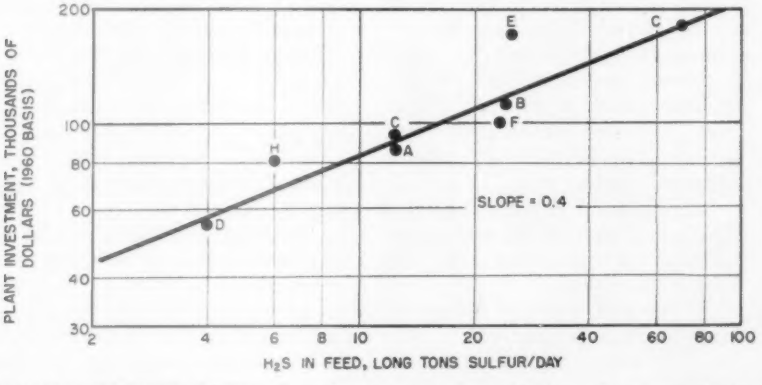
Operation. The following package units have been built and operated:

Plant	Feed Sulfur Capacity, LT/D	Year On Stream	Mole % H_2S in Feed (Dry Basis)	% Recovery
A	12.4	1956	66	93.5
B	24.2	1958	85	93.8
C	12.4	1958	92	93.1
D	4.0	1959	88	94
E	25	1960	71	90
F	23.4	1960	65	94
G	70	1960	52	93
H	6	1961	80	92

Construction is in progress for an 8.3-LT/D package unit in Montevideo, Uruguay and a 35-LT/D package unit in Montevideo, Uruguay and a 35-LT/D package plant at Port Arthur, Tex.

The smallest plant in the above group has operated at times at 2 LT/D. The largest package plant is 70 LT/D.

Maintenance costs. The maintenance costs of the package units have been low. The down time in Pan American's three package units has been 1 day per year for boiler inspection. This low down time also applies to the oldest unit which has been on stream for over 4 years. The annual maintenance cost for this unit has varied from less than 1% to 2% of investment per year. These low maintenance costs were achieved with part-time operator attention. A 12-LT/SD plant requires only about two man-hours per shift for checking temperatures and flows and moving liquid sulfur.



PLANT-INVESTMENT COSTS of package units are exclusive of gas-sweetening facilities. Fig. 2.

Construction costs. The plant investment costs of the various package units is shown in Fig. 2 as a function of plant capacity. These cost data are for sulfur plants exclusive of gas-sweetening facilities.

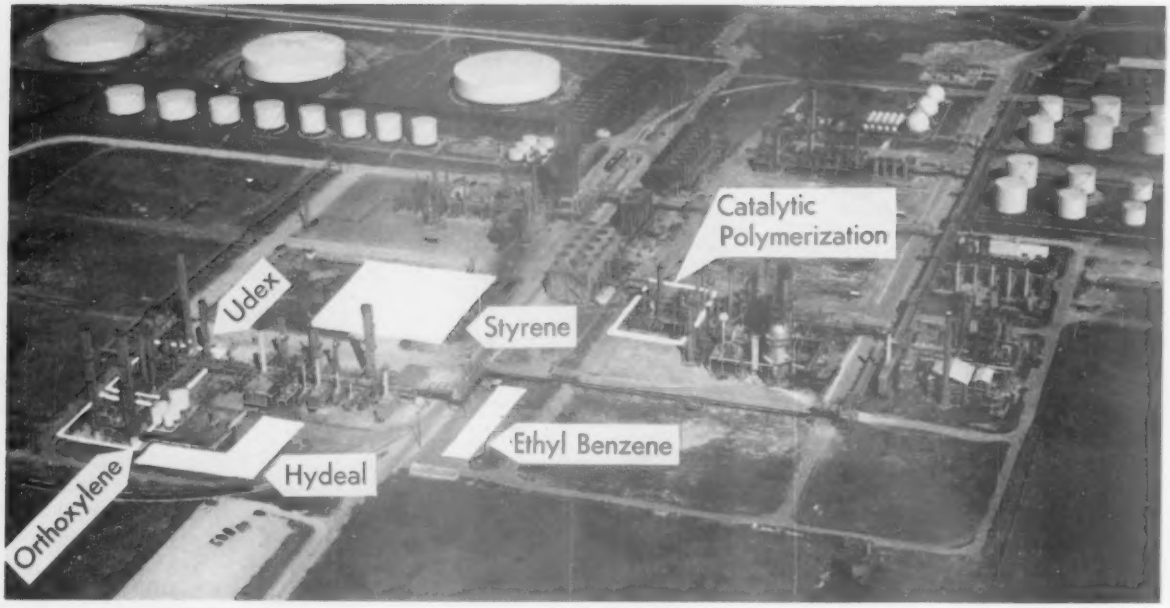
The cost of the 1956 plant has been escalated to 1960 by the factor 1.124. For 1958 and 1959 costs no escalation was necessary.

For one of Pan American's plants the equipment costs were distributed as follows:

	% of Total Equipment
Boiler and controls	30.
Air blower and motor	9.3
Reactor and catalyst	10.5
Electrical	7.2
Storage tank and pump	14.5
Burner, large valves	4.5
Insulation	5.1
Control instruments	5.2
Miscellaneous, fittings, pipe, etc.	13.7
	100.0

The maximum size of a package unit may be near 70 tons. The combined furnace, cooler, and condensers become excessively large for larger plants. Under some circumstances, however, it may be more economical to use two or more large package units than one conventional plant.

Processing notes



FOUR PETROCHEMICAL UNITS are in operation and three are building as . . .

Aromatics pace petrochemicals at Suntide

Benzene, ethyl benzene, orthoxylene, and styrene are principal products at the South Texas plant

A PETROCHEMICAL COMPLEX is taking shape at Suntide Refining Co.'s Corpus Christi, Tex., refinery. The company has moved strongly into petrochemicals with the emphasis on aromatics.

Suntide, a subsidiary of Sunray Mid-Continent Oil Co., has three units operating, one just completed, and another three under construction. Location of the petrochemical units is shown in the photo.

Udex extraction, catalytic polymerization, and orthoxylene fractionation comprise Suntide's three present operating petrochemical units. A hydrodealkylation unit (Hydeal) for making benzene from toluene was just finished. Ethyl benzene separation, styrene, and paraxylene units are now building.

Hydeal unit, of Universal Oil Products Co. design, almost triples Suntide's benzene production of about 450 bbl. daily. Feed stock is toluene from the Udex unit. The Platformer provides the hydrogen for conversion of toluene to benzene. Udex unit fractionation tower separates the benzene and toluene from the Hydeal unit.

Suntide did the construction of the Hydeal unit which cost about $850,000. It is the third of its kind built in the nation.

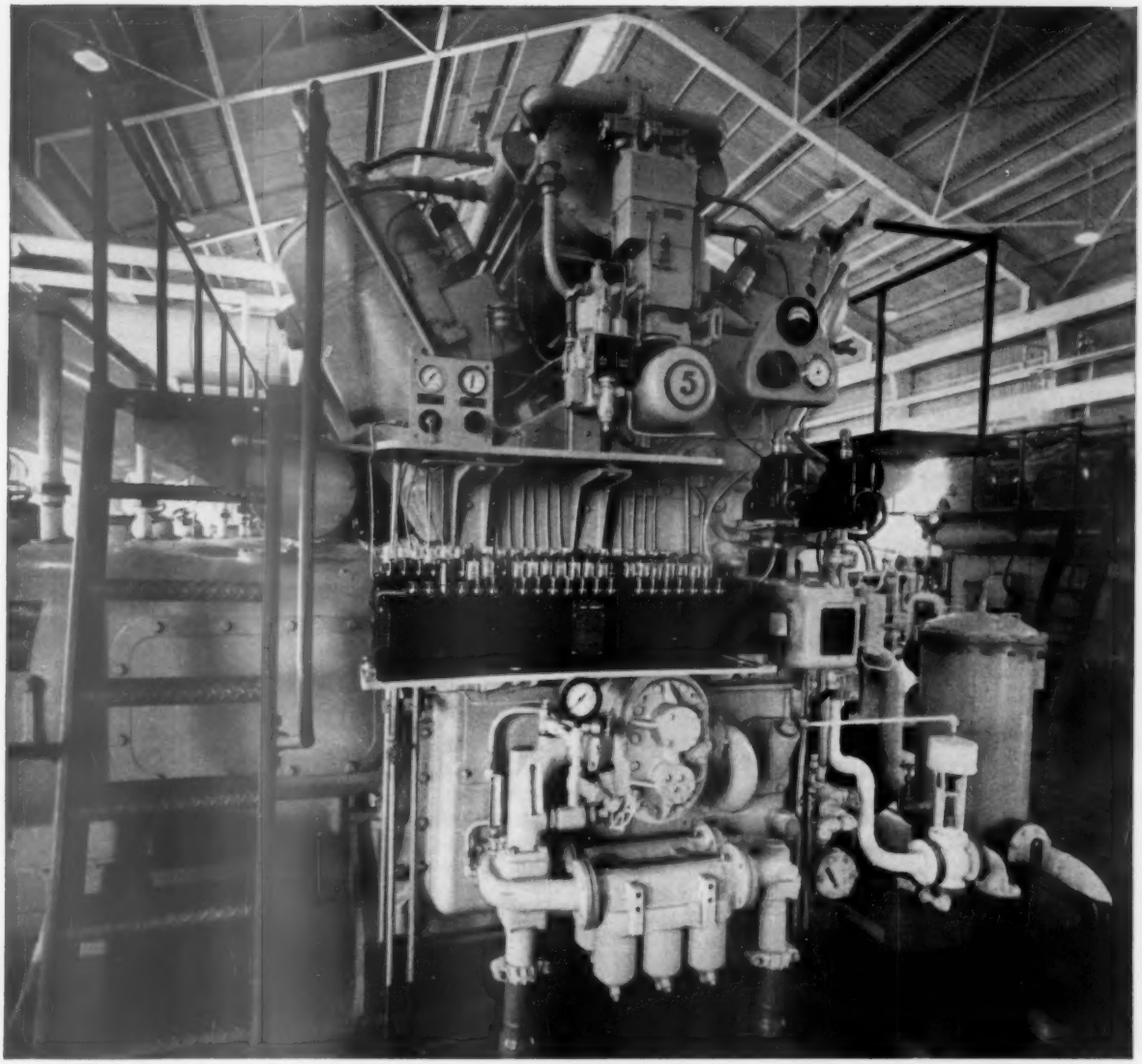
Styrene unit will have a capacity of 60 million pounds yearly. The unit will make ethyl benzene with ethylene from the cat cracker's vapor Udex and Hydeal units. Styrene will be formed by dehydrogenating the ethyl benzene.

The styrene unit is the first such unit for the Corpus Christi area. Production should start in 1962.

Ethyl benzene unit will have a capacity of 30 million pounds yearly. The unit will further separate the mixed xylene stream from the Udex and orthoxylene units. Ethyl benzene is a raw material for making styrene.

Overhead condensers will be air cooled heat exchangers. Completion is scheduled for July.

Paraxylene unit to be located just to the left of the orthoxylene unit in the above photograph will have a capacity of 15 million pounds yearly.



BENDIX MAGNETOS SPARK COOPER-BESSEMER ENGINES FOR EL PASO NATURAL GAS

Once again, Bendix* ignition equipment is proving its worth to the petroleum and natural gas industries. Shown here is a Bendix LAR magneto and Hi-V transformer coil installation at El Paso Natural Gas Company's Blanco Station in San Juan County, New Mexico. El Paso uses eight 1350 hp. Cooper-Bessemer gas compressors, all equipped with Bendix magnetos, at its mainline gas booster station.

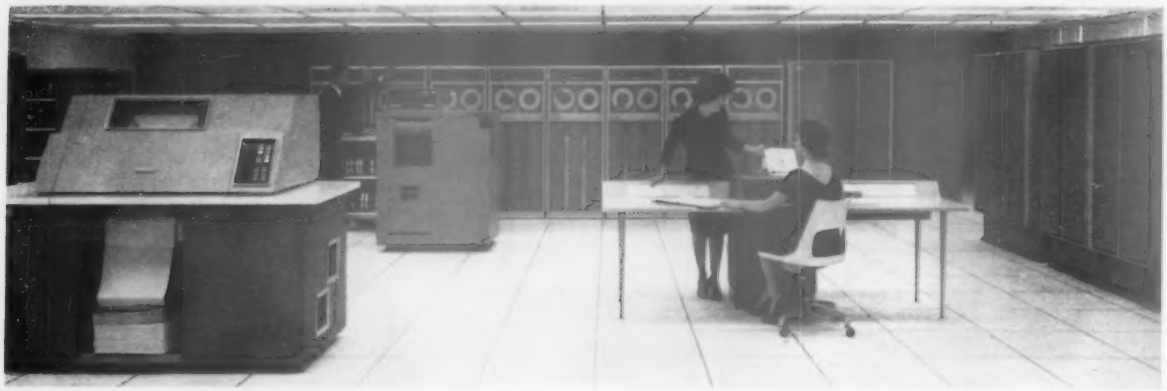
Bendix LAR magnetos deliver dependable ignition at the lowest practicable cost. Even under the most adverse operating conditions, their reserve power ensures smooth engine performance. The Bendix LAR magneto and Hi-V transformer coil form a matched ignition system to handle rugged engine requirements.

LA magnetos now in service can easily be converted to the modern Bendix LAR type with conversion kits now available. They can be obtained from your Bendix ignition distributor or from the factory. For complete details, write SCINTILLA DIVISION OF THE BENDIX CORPORATION, Sidney, New York.

*REG. TRADEMARK

Scintilla Division
SIDNEY, N. Y

THE Bendix CORPORATION



New computer service bureau

. . . has been opened in Wellesley, Mass., and plans for establishing a second bureau at University of Southern California in August have been announced by Minneapolis-Honeywell's electronic-data-processing division.

The immediate objective of the new bureaus is to provide strategically located facilities for predelivery checkout of computer programs, personnel training, and data-processing time for emergency use.

The equipment (left to right) in the Wellesley bureau includes a high-speed printer, card reader, magnetic tape units and their controls, console, floating point unit, and part of the central processor.

New oxo alcohol unit

. . . largest of its type, will produce octyl, decyl, and tridecyl alcohols from heptene, nonene, and dodecene at Gulf Oil Corp.'s Philadelphia refinery. The olefin raw materials are first converted to aldehydes by reaction with a carbon monoxide and hydrogen synthesis gas mixture, and the aldehydes are then hydrogenated to the alcohols.

Opcon controls styrene production

OPCON, an optimizing controller, has been used in the laboratory production of styrene to control ethylbenzene input rate, steam input rate, and operating temperature, F. J. Soderquist, Dow Chemical Co., told a joint meeting of the AIChE and the chemical-engineering division of the Chemical Institute of Canada in Cleveland.

"Broadly speaking, OPCON's reliability is as great or greater than that of the Standard instrumentation used in conjunction with it," Soderquist said.

As by nature OPCON is a hunt-and-seek mechanism a psychological factor is encountered when it is introduced to production people who are accustomed to the idea of smooth steady-state curves for optimum operation. Also, "the almost total absence of anticipatory control in OPCON is disconcerting. It is necessary to strictly limit OPCON's area of movement with limits of one type or another."

In 1957, Westinghouse Electric Corp., under a joint research agreement, furnished Dow with OPCON, plus a small special-purpose computer and the necessary supervisory manpower for the controller's installation and initial operation. Dow provided the process, suitable lab-

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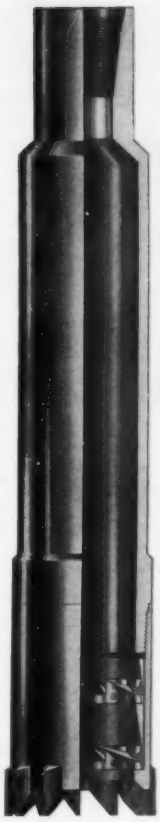

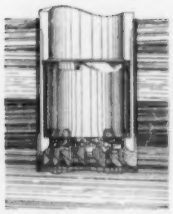

Globe Magnet type catcher. Circulation flows between basket head and magnet.

Both the upper and lower catcher dogs serve to hold ANY load securely while coming out of the hole.

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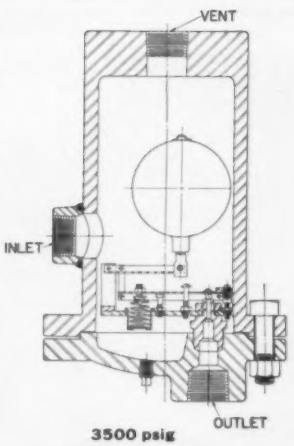
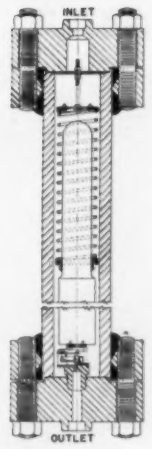
For the very high pressure ranges, where the use of conventional ball float drainers becomes impractical, Armstrong now offers open float and solid float liquid drainers for removing liquids from gas.

These drainers described briefly at the right are detailed with complete pressure and capacity data in Liquid Drainer Bulletin No. 400. This bulletin covers the entire Armstrong line of Liquid Drainers as well. Write for your copy today.



3500 psig

Open float liquid drainers utilize an upright bucket filled with the liquid being drained as a float. A spring provides the buoyancy necessary to open. Four models available for pressures up to 3500 psig.



5500 psig

Solid float liquid drainers utiilize an aluminum float counterbalanced by a spring to provide the necessary buoyancy. Available with or without an integral separator.

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DEEP, HOT HOLE, Standard Oil Co. of Texas 1 Logenbaugh in Harris County, Texas, was scene of first field trial of new mud-treating chemical. Even with 349° F. recorded at 15,000 ft., mud showed no ill effects. Rig is deep unit of Oil Production Maintenance Co., Houston.

It's a cost cutter on its first well, this

New chrome-lignite drilling mud

BY BILLY PARIS
Magnet Cove Barium Corp., Houston,
in collaboration with
C. O. WILLIAMS AND R. B. WACKER
Standard Oil Co. of Texas, Houston

FIRST FIELD TRIAL of a new experimental chemical mud additive has been a marked success and encourages us to believe lower mud costs are on the way for the Texas and Louisiana Gulf Coasts.

With the new additive, chemical costs are kept to an average of $1.16 per foot; this is unusually low for a 15,000-ft. well with bottom-hole temperature recorded at 349° F. Moreover, the new additive made the mud quite stable. For instance, when the drilling line broke and caused a 14-day fishing job, the mud was circulated through the pits once afterward to bring it up to excellent conditions.

The new chemical additive, called SP-20, is a chrome-lignite complex developed by Magnet Cove Barium Corp. Its first job was on the Standard Oil Co. of Texas 1 Longenbaugh recently drilled to 15,000 ft. in Southwest Cypress field near Cypress, Tex. The well is the deepest in Harris County. Contractor was Oil Production Maintenance, Inc., of Houston.

The mud stayed in excellent condition throughout drilling and completion of the well. After total depth was reached, 47 days were required for testing and completing. During this period there were sometimes intervals of 5 or 6 days in which the mud was not circulated.

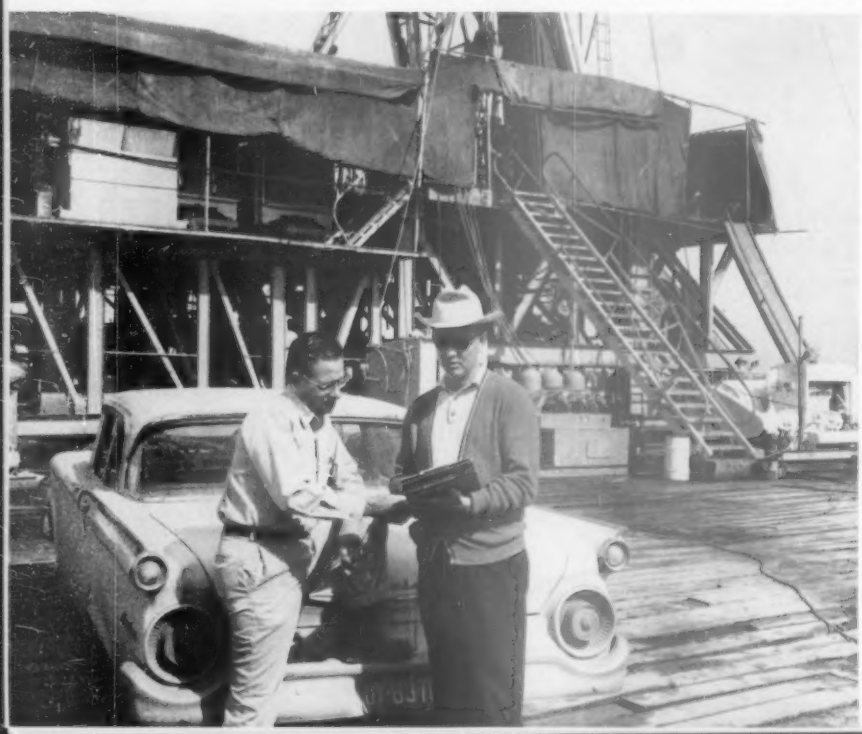
With the bottom-hole temperature of 349° F., it would not have been unusual for a conventional mud to gel. Yet, on the one occasion that the chrome-lignosulfonate-XP-20 mud showed indication of gelation on bottom, it was discovered that the mud had not had a complete treatment for over 2 weeks and that all it needed was a good drink of water.

Special high-temperature tools were required for the well completion. The cement had to be treated with a special retarder and 30% silica flour to combat the high temperature. During all these operations, only the mud stayed in good condition without special additives or treatment.

At no time during the completion was it necessary to make a trip to condition the mud in order to get wire-line tools to the bottom.

Fluid-loss control. XP-20 was successful in lowering the fluid loss from the moment it was added to the low pH-lignosulfonate mud. The

KEEPING CLOSE WATCH ON MUD are Author Billy Paris, on the right, and one of his collaborators, C. O. Williams. In addition to the supervision given the mud on location, samples were carried back to the laboratory daily. Checks there indicated the fluid might be used at temperatures up to about 500° F.



system was built with additions of chrome-lignosulfonate dispersant after an intermediate string was set at 9,770 ft. The SP-20 additions began at 10,112 ft. At this point, when ½ lb. per bbl. of XP-20 was added to the system, fluid loss fell from 6.8 to 5.6 cc.

A ratio of 2 to 1 was maintained in the additions of the chrome-lignosulfonate dispersant and the XP-20 until bottom-hole temperature rose above 300° F. Continued addition of XP-20 dropped the fluid loss to 1.9 cc.

While drilling below 13,000 ft. it was discovered that API and high pressure-high temperature filtration increased in proportion to the operating time of the centrifuge. It helped to add two sacks of bentonite to the system for each hour the centrifuge ran. But, when the centrifuge ran for more than 3 or 4 hours a day on the circulating system, the difference increased between the API and the high pressure-high temperature filtration. Centrifuging the mud was upsetting the particle-size distribution of the mud solids.

The problem was solved by jetting the excess mud to the "duck's nest" and then pulling the mud back through the centrifuge. By following this technique the weight material was salvaged, the mud weight was controlled more easily, the filtration properties remained more stable, and the flow properties remained in better condition.

Chemical costs. On wells drilled to 15,000 ft., chemical costs generally run well above the $1.16 per foot average of the 1 Longenbaugh, especially when bottom-hole temperature is above 300° F. Here is the chemical cost on the Standard of Texas well:

Chemical—	Amount	Cost
Chrome-lignosulfonate	38,000 lb.	$7,160.00
XP-20	39,000 lb.	6,860.00
Caustic soda	18,525 lb.	1,500.00
Drilling detergent	491 gal.	1,443.00
Phosphate	2,525 lb.	452.00
Total cost		$17,415.00
Cost per foot		1.16
Total mud bill		$77,863.48

Fishing operation. After 50 stands had been pulled on a routine trip from 13,244 ft., the drill line parted. The traveling block fell to the floor, breaking the drill pipe below the second joint of the fifty-first stand. As a result, 8,447 ft. of drill pipe and collars fell to the bottom of the hole.

Rig repairs took 4 days. Afterwards, another 2 days were needed to recover drill-pipe rubbers that had slipped off the drill pipe when it fell. After the top of the fish was tagged at 4,798 ft., the top 18 in. of drill pipe were milled off and three stands of wash pipe were run with outside cutters. The pipe was cut and 33 ft. recovered.

After an overshot latched onto the fish, the pipe was pulled and

TABLE 1

Well Depths when samples were taken, ft.	FLUID LOSS, in cc. API-Room Temp.	200 psi.-Room Temp.	100 psi.-250° F.	500 psi.-250° F.
12,500	2.8	2.5	10.0	9.6
13,000	2.3	1.7	11.2	9.8
13,910	4.3	2.9	11.6	8.0
14,284	4.3	4.1	14.4	12.8
14,757	4.4	3.7	17.6	12.0
15,000	4.5	5.6	*20.0	*11.6

*These results came from testing a sample taken from 15,000 ft. at 300° F.

TABLE 2—API MUD CHECKS MADE AT THE WELL SITE

Depth, ft.	Wt. lb./gal.	Vis. cp.	Apparent viscosity cp.	Plastic viscosity cp.	Yield point lb./100 ft.²	Gel strength, 0 and 10 min. gel	pH	Fluid loss cc.	Solids %	Oil %
6,400	9.7	43	20	15	10	0/5	8.5	10.5		
10,050	10.8	48	29	23	11	0/5	8.6	6.8	23	10
Added XP-20										
10,112	11.3	43	20	18	4	0/0	8.6	5.8	18	8
11,210	15.1	49	37	34	6	0/0	9.5	2.5	29	10
Logged-bottom-hole temperature of 300° F. at 12,554 ft.										
13,016	15.0	48	40	35	10	0/0	9.5	2.4	29	8
14,757	15.0	58	38	35	6	0/0	9.0	3.6	27	8
15,000	15.3	60	40	37	6	0/0	8.8	3.6	29	7
Logged-bottom-hole temperature of 349° F. at total depth.										

Note the unusually low yield points and the zero initial and 10-minute gels from the depth at which XP-20 was added down to total depth. This represents a major achievement when the temperature and the low chemical costs are considered.

TABLE 3—RESULTS OF HIGH-TEMPERATURE TESTS USING AS BASE MUD THE ACTIVE MUD FROM THE 1 LONGENBAUGH WHEN IT WAS CIRCULATING AT 15,000 FT. PRIOR TO LOGGING

	Wt. lb./gal.	Apparent viscosity cp.	Plastic viscosity, cp.	Yield point, lb./100 ft.²	Gel strength, 0 and 10 min.	pH	Fluid loss, cc.	Ca, p.p.m.	Shear, lb./100 ft.²
Base (unheated)	15.6	32	31	2	0/5	8.6	4.5	160	....
Base after 16 hours at 300° F.	15.6	44	41	6	0/7	8.6	4.3	200	130
Base after 48 hours at 300° F.	15.6	52	47	9	0/17	8.3	3.9	240	130
Base after 64 hours at 300° F.	15.6	38	35	5	0/20	7.6	4.4	120	135
Base after 168 hours at 400° F.	15.6	65	51	28	8/103	8.6	9.2	80	600
Base after 240 hours at 400° F.	15.6	73	49	47	18/134	8.7	8.8	40	700
Base after 336 hours at 400° F.	15.6	69	52	33	15/103	8.9	11.8	80	1,050
Base after 720 hours at 400° F.	15.6	83	34	98	78/157	8.4	12.2	80	740

worked to a maximum of 290,000 lb., 44,000 lb. over the weight of the fish. A free-point indicator showed the fish to be free to 10,412 ft. When an attempt was made to put left-hand torque in the pipe to back it off at 10,400 ft., the rotary lock slipped and cut the wire line at the surface. The free-point indicator and 10,400 ft. of ⅜-in. wire line dropped into the hole.

A wire-rope spear was intentionally tangled in the fish and the wire pulled out its socket; this was to keep the ⅜-in. wire from falling farther down the drill pipe. The drill pipe was then backed off above the spear. Wash pipe with outside cutters was run and the drill pipe cut off below the spear at 2,617 ft. Then, 167 ft. of drill pipe, 10,400 ft. of ⅜-in. wire line, the wire-line spear, and the free-point indicator were recovered.

An overshot then latched onto the fish and the drill pipe backed off at 10,416 ft. All but 2,828 ft. of drill pipe and collars was recovered.

The wash pipe with the spear was rerun to 10,970 ft. A maximum pull of 270,000 lb. freed the fish recovering all the remaining fish with the exception of three bit cones. These were recovered in two trips with a junk basket.

Fourteen days after the mishap, the bit was back on bottom and drilling. Much of the success of the fishing operation can be attributed to the stable condition of the mud. Despite 3,474 ft. of open hole, and a temperature in excess of 320° F., the mud stayed in excellent shape. After the 14 days, the mud was circulated off bottom in good condition. One circulation returned the mud to its original character.

Laboratory findings. XP-20 had been subjected to extensive laboratory tests before its use on the 1 Longenbaugh. Still, mud samples were taken almost daily to the Magcobar laboratories for complete analysis to observe the stability of the flow properties at high temperatures, and to obtain high temperature-high pressure filtration data. These tests helped maintain a desirable chemical and solids balance in the system.

A new type cement consistometer* was adapted for the first time to test the pumpability of the 1 Longenbaugh mud under high temperature and high pressure. The consistometer measures pumpability by means of a soft-iron bob located in a cylindrical sample cavity. The bob is caused to move up and down through the test fluid in a manner similar to a loose-fitting piston. Two electromagnets, one above the other, are alternately energized by a timer switch to cause the bob movement.

In a testing operation, the bob begins at the bottom of the cavity and goes through a complete cycle. The top electromagnet is switched on and, at the same time, a timer started. Pulled up through the test fluid, the bob strikes the top of the cavity, causing a sound that is sensed by a microphone. The sound of the bob striking the top of the cavity stops the timing circuit and the bob travel time is recorded on a strip chart. The bottom electromagnet is then energized to return the bob to the original starting point. Any increase in viscosity of the test fluid appears as a longer travel time on the continuous chart.

The temperature limits of a sample of the chrome-lignosulfonate-XP-20 mud from the 1 Longenbaugh was determined to be 505° F. when tested under 10,000 psi. As this high temperature was reached, gelation started. After the sample cooled, gentle agitation returned the mud to low gel strength fluid, confirming that gelation and not solidification had occurred.

In another test with the consistometer, some of the same base mud was subjected to 10,000-psi. pressure at 375° F. for 7 continuous hours. Change in viscosity or pumpability was quite small, further indicating stability of the mud system at high temperatures.

Perhaps the most significant test results came when 1 Longenbaugh mud was subjected to high temperatures and differential pressures in high pressure-high temperature filter presses to determine the compressibility of the mud cake. Table 1 shows results from these tests; at high temperatures, an increase in pressure reduces the fluid loss of muds treated with XP-20.

In another high-temperature control test (see Table 3), the mud was checked to see if it could be used as a packer fluid. The mud proved quite stable under high temperature and, as a result, was left in the hole above the packer.

In the test, samples of the mud were taken from the 1 Longenbaugh at 15,000 ft. and sealed in high-temperature bombs. All samples were from the same large bucket taken from the flow line. All samples were aged at 300° or 400° F. for varying periods. Following the aging, the samples were cooled and properties compared to the original unheated base mud samples.

Several samples of mud were tested at 400° F. in a static condition. They were left at this temperature for periods of 168 hours, 240 hours, 336 hours, and 720 hours. After cooling to room temperature, all samples were refluidized with gentle agitation. Normally, muds maintained at 400° F. for 48 hours solidify and cannot be returned to a fluid state even with extreme agitation.

Editor's Note

Since this article was prepared, The Oil and Gas Journal has learned that two other wells have been drilled with chrome-lignosulfonate-XP-20 mud—one in South Louisiana the other in South Texas. Compared with an offset well, the well drilled in South Louisiana showed a savings of over 45% in the drilling-mud cost. While there was no comparable offset well to the one drilled in South Texas, the mud on it remained extremely stable at a temperature of 299° F. at 15,600 ft. During 4 days of logging the mud required no treatment. Also, on the South Texas well, the penetration rate was unusually high, almost the same below 10,000 ft. as above 10,000 ft.

*Model TDL-3S made by Fann Instrument Corp., Houston.

BOOK

BLAZER AND ASHLAND OIL. By Joseph L. Massie. Published by University of Kentucky Press. 253 pp. $5.

Here is a study of the management of Ashland Oil & Refining Co. during the 33 years of Paul G. Blazer's administration.

Ashland Oil, under Blazer's guidance, made its own management rules and principles in its fight for growth. The author concludes that Ashland's spectacular success is due to practices which didn't conform to accepted principles of corporation management.

Flexibility is pointed up by the author as the key principle of Blazer's policies which enabled this small, growing organization to compete successfully witth larger and more conventionally operated companies.

But the success of these methods tended to their own obsolescence as the company grew larger and was compelled to move toward more conventional management practices.

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Slim-hole rod pumping

BY JOSEPH ZABA

A "SLIM-HOLE" completion is defined for the purpose of this discussion as one in which a string of 2⅞-in.-o.d. tubing has been set and cemented as casing. Although there are some differences of opinion about the economic value of such completions, they are being widely used by some oil-producing companies because of savings in cost in tubular goods.

Sucker-rod pumping is frequently used for lifting wells completed in this manner. In the last 2 or 3 years a complete line of rod-pumping equipment has been developed and at least three different methods of approach are in use.

Casing-pump arrangement. If a regular insert-type sucker-rod pump is set into a seating nipple in a 2⅞-in. "casing" string the arrangement is, in effect, that of a casing-rod pump of a conventional completion. This method has the advantage of simplicity and conventional surface and subsurface equipment can be used. Also, under applicable conditions, maximum volume of fluid can be produced with the available size of the eductor tube.

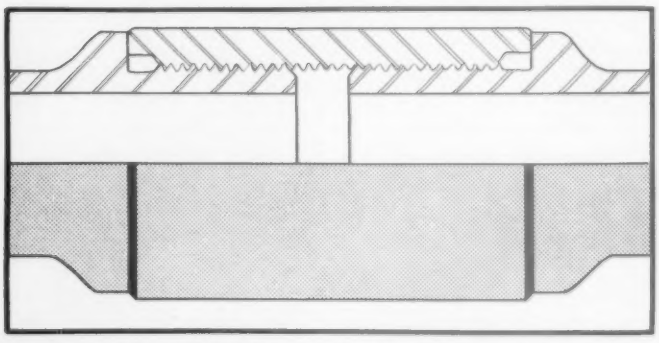
The method, however, has serious limitations: (1) all the gas has to be handled by the pump, (2) cases are known in which the volumetric efficiency of the pump was so low that other methods of pumping had to be employed, (3) rod-on-tubing wear can be a real problem, and (4) sticking of the pump may lead to difficult fishing jobs. Variations of the method are available which take care of at least some of the potential difficulties. These variations, however, detract from the principal advantages of the method, which are simplicity and low cost.

Scaled-down pumping. Conventional subsurface rod-pumping equipment has been scaled down for use inside 2⅞-in.-o.d. tubing, the drift diameter of which is 2.347 in. The tubing may be 1¼-in. nominal seamless with drift diameter of 1.286 in. The outside diameter of the coupling of this tubing ranges from 1.858 to 2.200 in. depending on the type of joint used. Sucker rods of ½-in. size with 1-in.-o.d. couplings are already an API Tentative Standard (Part 17). Rod pumps with bore of ⅞ in. and top or bottom holddowns of 1¼-in. tubing pumps are used. Or 1½-in. nominal seamless nonupset or special-joint tubing with drift diameter of 1.516 in. may be used. This tubing will accommodate ⅝-in. sucker rods with 1¼-in.-o.d. couplings and 1½-in. tubing pumps may be used.

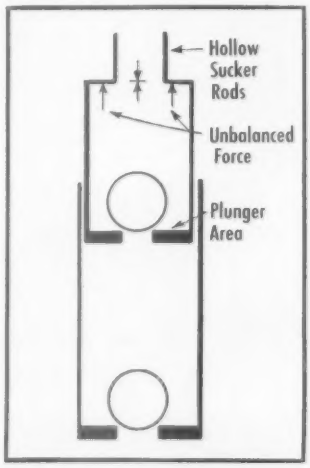
The system offers all the flexibility of conventional rod pumping. Because of relatively low rod weight, there is some savings in size of surface equipment. Size of rods and pumps imposes depth and volume limitations.[1] Also, since both rods and tubing are used, the economic advantage of a slim-hole completion is reduced in comparison with the casing-pump arrangement described above.

Hollow sucker rods. As previously mentioned (Part 21) hollow sucker rods have been used for many years in a number of applications. With the increased number of slim-hole completions it was only natural that hollow rods were considered as a means of pumping such completions. Many installations used small tubing as rods, usually of 1-in. nominal diameter. However, some difficulty was experienced with leaking couplings and unscrewing or breaking of joints. These difficulties were brought about by bending stresses for which the ordinary tubing joints are not designed, the stresses being brought about by compressive forces to which the hollow rods are subjected. To overcome these difficulties different special joints have been developed for the hollow rods. The designs of these joints differ, but they have one feature in common: they are shouldered to protect the joint from the bending stresses (Parts 15 and 16). At least three types of joints are now successfully used. The design of one of them is shown in Fig. 53. A special task group of the API Committee on Standardization of Sucker Rods is now working on the proposed standards for hollow sucker rods.

Bending stresses in hollow-rod joints are a result of compressive force to which the rods are subjected. This is an unbalanced hydraulic force which exists in the hollow-rod pump system. As shown schematically in Fig. 54 this force equals the hydrostatic pressure of fluid in the hollow rods acting upwards over the area which equals the area of the plunger less the inside area of the rods. This force increases as the ratio of the internal diameter of hollow rods to the plunger



ONE OF SEVERAL DESIGNS of a shouldered hollow-sucker-rod joint. Fig. 53.



UNBALANCED hydraulic force in hollow-sucker-rod pumping increases as the ratio of the internal diameter of hollow rods to plunger area increases. Fig. 54.

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For example, bearings must have fatigue strength to stand up under the pounding of millions of shaft revolutions. Some new engines, however, have greatly increased bearing pressures and require a new kind of bearing. Federal-Mogul's answer is the overplated aluminum alloy bearing, one of those shown above. It can take loads of 6,000 pounds per square inch . . . three times the pressure of conventional babbitt bearings.

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area decreases. It has been pointed out that tubing buckling in conventional rod pumping (Part 18), occurs also in hollow-rod pumping except that in the latter case the buckling of the hollow rods occurs on the downstroke.[2]

Bending not only subjects the rod joints to undesirable stresses, but may also be the cause of severe rod-on-tubing wear. The unbalanced hydraulic forces may be eliminated, for all practical purposes, by the pressure of fluid within the annulus. This largely equalizes the unbalanced hydraulic force and buckling is eliminated. Annulus may be loaded with a dead fluid while the well fluid is produced through the hollow rods. With this arrangement gas cannot be vented. Or, one of the commercially available crossover pumps may be used. In such a case the well fluid is pumped through the annulus and the gas is vented through the rods.

Hollow-rod system. Insert pumps, preferably of the traveling-barrel type, are used with hollow rods attached to the pull tube or the cage. The pump is installed in the seating nipple or a packer-type pump anchor is used. If the fluid is being pumped through rods, it may be conducted from the well to the flow line through the hollow polished rod and flexible hose. Or a special packoff is provided in the casing at the surface which permits taking off gas and fluid at separate wellhead connections.

Because of high velocity of fluid in the hollow sucker rods, sand can be handled satisfactorily. Paraffin deposition in sucker rods can be minimized by plastic coating. Care must be exercised in running the hollow rods so that they are not damaged in handling.

Suggestions have been made and discussed for modification of formulas used in calculation of conventional rod installations so that these formulas can be applied in design of hollow-rod installations.[3 4 5] Not enough field experience or dynamometer data are available to fully appraise the validity of these suggestions. They do provide, however, a basis for such calculations. The following general considerations apply:

If the fluid is produced through the hollow rods the unbalanced hydraulic force, previously mentioned, reduces both the maximum and the minimum polished-rod loads. In calculating the maximum load with available formulas (Part 7) it should be noted that the fluid load is equal to the weight of the volume of fluid in the hollow sucker rods. This load is therefore independent of the size of the pump. Also, all the fluid is accelerated the same way as the rods, when the traveling valve closes. In case of the minimum load on the downstroke (Part 7) the buoyancy factor may be neglected. At high rates of production the friction of fluid in the hollow rods may become a factor, increasing the unbalanced hydraulic force on the downstroke, which is the pumping stroke. This force also reduces overtravel of the plunger to a minimum. If the fluid is pumped through the annulus with a crossover pump the fluid load is based on the size of the pump. Conventional load formulas are applicable. Both buoyancy and plunger overtravel are present. In all calculations of this type the stresses are determined by dividing the loads by the metal area in the body of the rods.

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1. Jack D. Gale, "Small Rods Mean Big Savings": Petroleum Engineer, April 1960.
2. Arthur Lubinski and R. P. Vincent, a memorandum, November 1959.
3. G. R. McDannold, "Pumping Through Macaroni Sucker Rods": Proceedings seventh annual West Texas oil-lifting short course, Texas Technological College, April 1960; see also The Oil and Gas Journal, August 1960.
4. R. M. Erskine, "Slim-Hole Completions, Planned Selection of Pumping Equipment": A paper presented at the meeting of the Mid-Continent District of the API Division of Production, Wichita, March 1960.
5. William B. Shannon, "Pumping Installations in Ultra-Slim Casing": Petroleum Engineer, April and July 1960.

Nelson refinery cost indexes

Published in the first issue each month in the Technology-Operation Section.

Compiled by W. L. Nelson, Technical Editor and petroleum refinery consultant, Tulsa.

Charts of the indexes are published each year in a late January or early February issue.

Indexes of selected individual items of equipment and materials are also published on the Costimating page in the first issue of the months of January, April, July, and October.

Refinery Construction Cost Index (1946 Basis)

Explained on Page 101 of the issue of August 5, 1957

	1950	1954	1957	1958	1959	1960	Jan. 1961
Pumps, compressors, etc.	138.2	166.5	206.7	214.7	226.5	228.3	228.6
Electrical machinery	134.9	160.0	188.9	192.7	195.8	195.2	193.1
Internal-comb. engines	126.0	150.5	173.9	178.3	178.5	180.7	181.2
Instruments	127.8	154.6	187.4	194.9	201.0	202.5	207.5
Heat exchangers	140.0	171.7	203.6	181.2	178.9	194.0	186.8
Misc. equip. average	*126.2	160.7	192.1	192.4	196.1	200.0	199.6
Materials component	149.5	174.6	201.9	204.2	207.8	207.6	207.6
Labor Component	144.0	183.3	208.6	220.4	231.6	241.9	†245.5
Nelson construction index	146.2	179.8	205.9	213.9	222.1	228.2	230.3

*Used in computing the Nelson Index until April 1952. †Converting Labor Component to 60% skilled labor rather than 50:50. Transition will be complete by May 1961.

Refinery Operating Cost Indexes (1956 Basis)

Explained on Page 171 of the issue of June 1, 1959.

	1946	1952	1954	1958	1959	1960	Dec. 1960
Fuel cost	49.6	81.0	86.5	102.1	103.5	109.9	112.9
Labor cost	73.1	88.7	90.9	105.0	102.3	100.3	98.0
Wages	52.4	81.5	88.7	105.4	111.5	113.0	113.1
Productivity	68.3	90.2	97.1	100.3	109.0	112.9	115.3
Investment, maint., etc.	51.2	83.6	92.0	109.5	113.7	116.9	117.4
Chemicals cost	37.0	72.1	85.7	104.4	107.8	114.3	114.7
Operating cost indexes:							
Refinery	58.5	80.5	88.7	105.8	106.8	108.8	108.5
Process units‡	62.9	82.2	88.4	105.8	106.0	107.2	106.8

‡Add separate index for chemicals, if any are used.

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TEMPORARY ISLAND is joined to south bank of Arkansas and four lines laid to south tie-in. Distance from north to south tie-in was approximately 5,500 ft., with 4,500 ft. requiring excavation below water table, 550 ft. of which was directly in the river channel.

On the Job

PIPELINING

Line crossing uses well points

BY JOHN P. O'DONNELL
Assistant Pipeline Editor

ECONOMY and convenience were two factors that determined the choice of a well-point system for a multiple pipeline crossing of the Arkansas River. The well-point system was chosen after alternative means had been considered.

The choice was made by Williams Brothers Co. which had contracted to lay four lines across the river for Service Pipe Line Co. One was an existing 20-in. line that had to be lowered while the others, two 12-in. and one 16-in., were new.

Cost and ease of operation shared about equally in the decision. Cost was lower by the well-point method and it avoided underwater work, thus making the operation easier.

The distance from tie-in to tie-in was approximately 5,500 ft. Some 4,500 ft. required excavation below the ground water table. One-fifth of the latter was in the river bed and 550 ft. directly in the channel.

Dry method. Successful bidder on the dewatering equipment was the John W. Stang Corp. which had previously done work in the immediate area. It recommended the "excavation in the dry" method. This method eliminated both dredging and sheeting and made it possible to do all excavation and pipe laying "in the dry."

A Stang well-point system was used to lower the ground water table and stabilize the excavation slopes. This dewatering operation made it possible to maintain a dry ditch throughout the job even with excavation as much as 20 ft. below the river pool. Slopes were held to a maximum of 1:1.

In this system, a well-point pump with discharge lines is connected to a suction header manifold. The header is connected to well points by individual swing joints and risers. The well-point pump is combined with an air separation chamber and vacuum pump.

The vacuum pump is used to draw off air that may accumulate in the line through leaks or may be drawn through the well points. Accumulation of air is most common on short lifts.

Shorty type. Well points used on this job were the so-called "shorty" type which was designed especially for pumping off rock. These well points permit drawdown closer to the top of the rock than can be accomplished with the conventional, longer well points. The drawdown desired, depth to impervious-

One of three International T-340 crawlers used by a prominent Midwest utility company for laying distribution lines. The T-340 shown laid 6,000 feet of six-inch main, replacing a 67-year-old four-inch line on this particular job.

Save the expense of an additional tractor by using the T-340 boom tractor for backfilling. Six-foot blade is hydraulically controlled. It can be angled manually 25 degrees right or left for bedding down the pipe safely.

Husky, low-cost 47-hp* crawler...

handles line pipe up to 6 inches

Now you can have crawler tractor pipe-handling at a cost-cutting price for the multitude of jobs requiring 6,500-lb sideboom capacity or less. International T-340 is priced thousands of dollars less than the next larger size sideboom crawler.

With 66-inch track length ground contact, the T-340 has excellent flotation in soft footing with 10, 12 or 14-inch shoes as conditions require. Bolt-on rubber shoes permit work on city streets without damage to pavement. Compact size of tractor makes job-to-job moves by small trailer fast and easy.

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Twelve-foot boom gives the T-340 "boardinghouse" reach so that the tractor can remain on firm footing in rugged terrain. Constant load control prevents accidental dropping.

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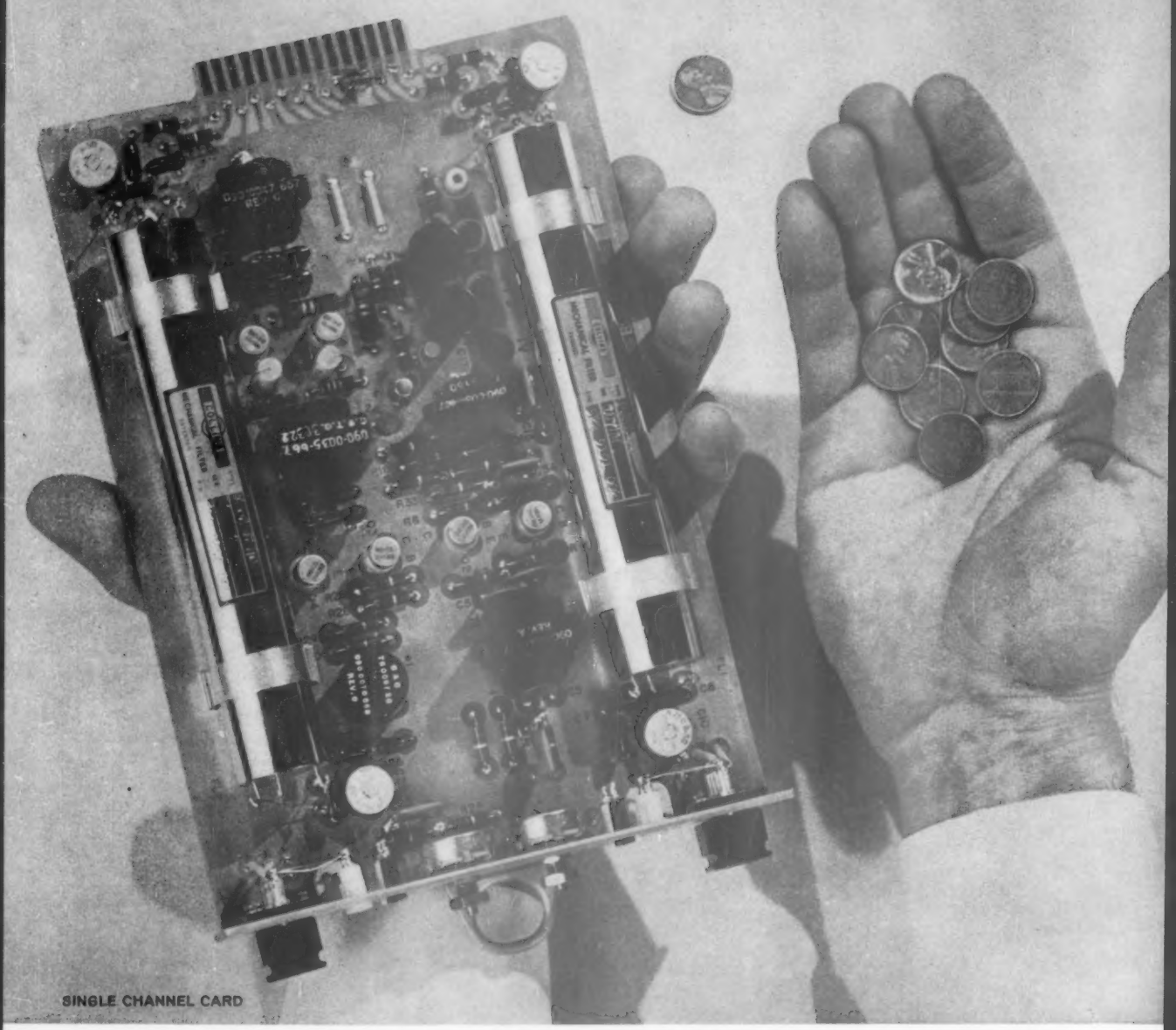

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WELL POINTS, header, pump, and discharge line of dewatering system are shown at the right. Crew at left is coating and wrapping welded joint of 16-in. line, one of four lines in multiple crossing.

ness, and the permeability of the water-bearing formations determine the type of well point to be used.

Excavation began at the north end of the project and it was necessary to begin dewatering almost immediately. Installation began with the laying and coupling of the header line over the section of ditch that had been opened to the water table.

Self-jetting well points, equipped with risers, were jetted down. The jetting system delivered approximately 300 g.p.m. at 150 psi. The well-point risers were then connected to the header manifold with swing joints.

The well-point pump, with a discharge line, was connected to a tee in the manifold and this portion of the system placed in operation. The system was designed to handle up to 15,000 g.p.m., and actual volume was within the predicted range so that the capacity was ample to accommodate any emergency.

Flexible system. The initial installment was approximately 600 ft. in length. It was extended as the excavation to the water table was continued. As the extension was made, gate valves were located in the manifold line between the pumps. This gave the system flexibility.

As a portion of the pipe laying was completed and backfilled, the section of the well-point system serving that portion could be blocked off at the gate valve. That section was then taken up and moved ahead. This kept the dewatering system well in advance of the excavation and pipe-laying operation.

When the excavation reached the river channel, sand dikes were pushed into the river, rising some 5 ft. above the river pool. The well-point system was installed inside the dikes and excavation completed to final subgrade.

The river was progressively crowded to the south bank into a 100-ft. channel. This had the effect of raising the river pool and deepening the channel.

Diversion channel. The pipelines were laid to within 150 ft. of the south bank. While dewatering and pipe laying continued, a diversion channel was prepared on the north side. An earth plug was left between the diversion channel and the river. When this plug was breached, the work area was an island.

The channel between the island and the south bank was closed a day later and the entire operation continued on to the south flood plain and to the south tie-in

Despite a 7-day delay because of inclement weather the job was carried to the south bank March 9, the scheduled date. The accompanying aerial photograph was taken on March 7.

The bad weather hit before the pipe-laying work had started. A 2½-ft. rise in the river delayed the south closure 24 hours. The entire job was completed March 25, well ahead of schedule. Project Manager Jim Martindale of Williams Brothers was in charge of the operation and Bill Reiff, a Stang supervisor, was retained by Williams Brothers to supervise the dewatering.

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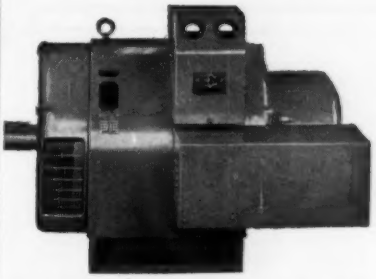

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OPERATOR at this console controls entire loading operation at Standard Oil Co. of California terminal at Carpinteria, Calif. Pump and valves are operated and tanks gaged from single point.

One man loads tankers

TANKER LOADING is carried on efficiently at the Standard Oil Co. of California pipeline loading terminal at Carpinteria, Calif., a few miles to the south of Santa Barbara.

The loading operation is simplicity itself. A desk console with a graphic diagram controls the entire loading operation. An operator sitting at the console starts and stops the loading pump, opens and closes valves, gages the tank, and communicates with the ship by FM radio.

The operator regulates a throttling valve from the console to deliver crude to the tank at any desired rate of flow up to the capacity of the pump. Flow rates and shore pressures are recorded on strip-chart miniature instruments.

The graphic controls make it easy for personnel from other pipeline jobs to operate the terminal.

The Carpinteria terminal handles crude oil produced from two offshore drilling platforms south of Santa Barbara. The crude is brought ashore by submarine pipelines. After gas has been removed and royalty gaging performed, the oil is delivered to the pipeline department's single 217,500-bbl. tank.

A 20-in. submarine pipeline runs from the shore facilities to the moorings of an existing sea terminal installed some years ago to deliver gasoline and other light products to the marketing department. Every month or so, at present production rates, a tanker arrives to take the accumulated crude.

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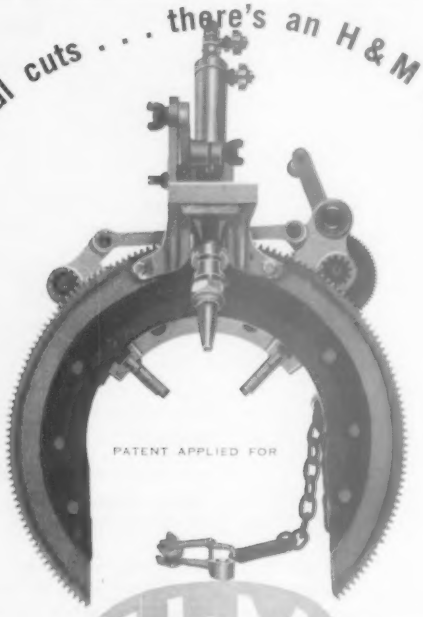

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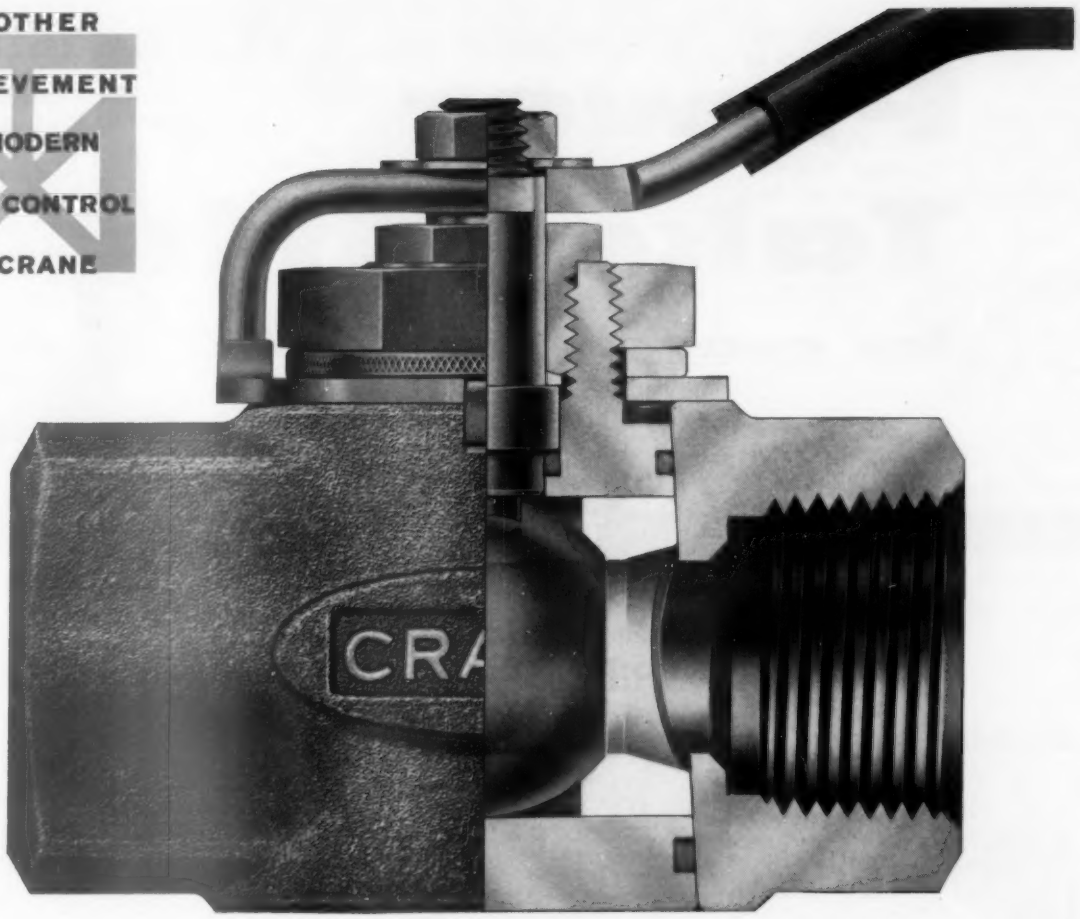

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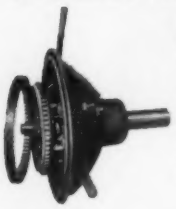

Easy-to-mount unit consisting of clutch PTO assembly with shaft and bearings in a rigid cast iron housing. Designed for manual operation on all internal combustion engines with standard SAE flywheel housings from No. 6 to No. 00. Triple-plate 14" to 21"; double-plate 11½" to 24"; single-plate 6½" to 24". Twenty models with horsepower capacities to 600 hp and torque capacities to 6730 lbs.-ft.

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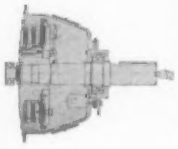

A new series combining the convenience of Model PO Air Clutches with the time-tested dependability of Twin Disc Friction PTO's. Ideal for drilling rigs where the operator must work from a remote driller's platform. A touch on a control valve handle engages and disengages the clutch . . . provides "torque without effort." Normally requires only 90 psi air pressure. Capacities to 600 hp. Conversion kits available.

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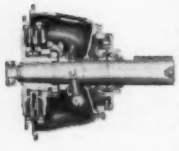
A modified version of the standard Twin Disc PTO. Features a new clutch engagement mechanism that virtually eliminates throw-out collar wear, ends daily greasing for good. In oilfield pumping jack service this PTO will quickly pay for itself in labor savings alone because it needs greasing only twice a year. Available in 10", 11", 14", and 18" sizes. Conversion kits for older PTO's also available.

FLUID PTO (Model HU)

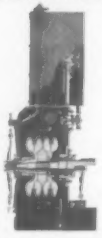
Used on constant-speed, constant-torque drives where efficiency of 95% or better is desired. Consists of a fluid coupling combined with a cast bell housing, bearings and output shaft. In oilfield pumping installations, Model HU improves engine operation by reducing variation in engine rpm per stroke by as much as 50%. Also cuts engine vacuum variation for lower BMEP. Sizes: 14.5, 17.5 and 21.

NEW "HIGH-ENERGY, HIGH-SPEED" PTO



A recent Twin Disc development for engines developing 300 to 500 hp at speeds up to 3380 rpm. Designated Model IBF-214P, it has a unique ventilated center plate that permits air flow to dissipate excess heat. An amazing ability to withstand high-energy loads makes this PTO well suited to applications where equipment is subject to heavy starting loads. Tapered roller bearing is continuously lubricated with oil. Improved throw-out collar design permits extending greasing periods up to six months.

DISCONNECTING FLUID PTO (Model HUD)



Disconnects power source from driven equipment to reduce impact shocks 70% or more. Eliminates "engine fighting" to assure balanced distribution on compounds. Life of chains, clutches and other running parts is almost doubled. Isolation of torsional vibrations and elimination of slow-speed lugging saves wear and tear on engine. Furnished with 21" or 27" double-circuit fluid couplings for engines with #0 and #00 housings in the 100 to 600 hp range.

For product information and application recommendations contact our Racine office or the Twin Disc Factory Branch, 1511 Turtle Creek Blvd., Dallas 7 (phone Riverside 1-3014).

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin • HYDRAULIC DIVISION, Rockford, Illinois

What's NEW . . . in equipment

All-weather tank breather valve

During a 2-year field test a new breather valve installed on benzene tanks in Sidney, N. S. performed perfectly under extreme weather conditions with a product that froze at temperatures between 36° and 38° F., the maker reports. The valve reportedly worked equally well during hot, humid summer weather.

The all-weather valve, on both pressure and vacuum pallets, uses a flexible diaphragm of a material which is said to be nonfrosting and icing-resistant. This diaphragm is said to protect against the pallets freezing closed and assures vapor tightness under all types of weather conditions.

A flip-top cover which is quickly released by twisting two spring-loaded release handles permits simplified inspection and maintenance. Source: **Vapor Recovery Systems Co.,** 2820 N. Alameda, Compton, Calif., U.S.A.

Need more facts on the items described on these pages?

The manufacturers will gladly supply them. They're shown in bold type, with their addresses. For convenience, send this coupon to the manufacturer.

ITEM _____

_____

OIL AND GAS JOURNAL

June 5, 1961

NAME _____

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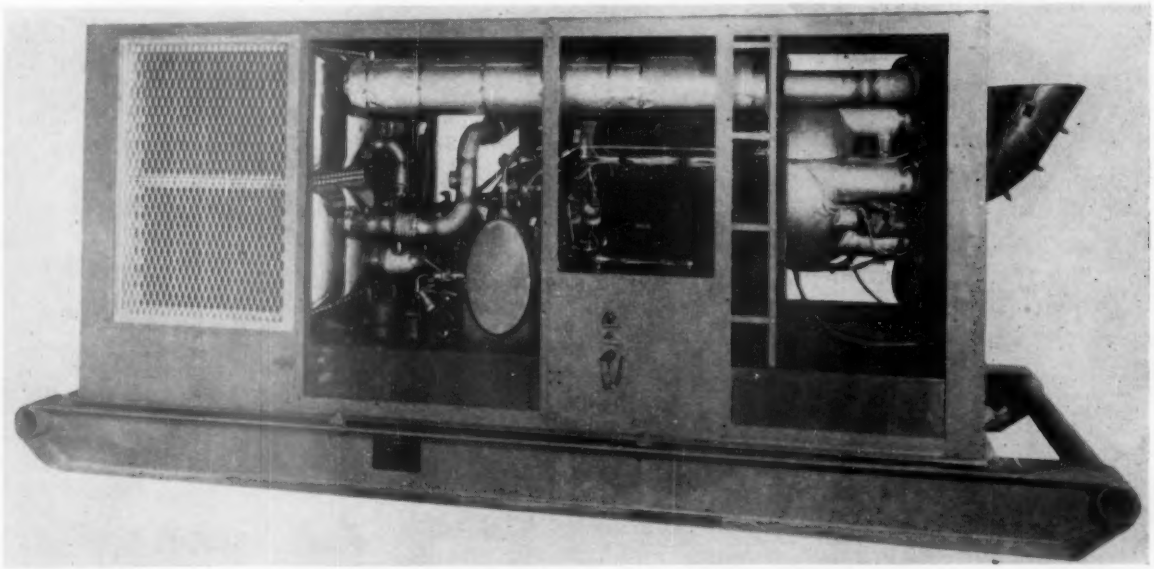
COMPANY _____

ADDRESS _____

CITY _____

STATE _____



Packaged gas turbines developed for 30 to 850-hp. range

THREE GENERAL TYPES of gas turbines are used in a new packaged line of turbines. One type supplies energy in the form of compressed air, another in the form of shaft power, and a third provides shaft horsepower and compressed air power simultaneously, or either form of power independently and interchangably.

The basic package consists of the gas-turbine compressor and power unit mounted on a skid, enclosed against the weather, with heat exchanger, operating controls, and safety devices.

All phases of operation and maintenance of the packaged unit can be readily accomplished by one operator—even if two or more units are operated together. The units are equipped with a fully automatic control system which properly sequences starter operation, fuel control, and ignition to provide a stable automatic starting cycle requiring only one starter switch.

Available with ratings from 30 to 850 shaft hp., the maker says the units start dependably and quickly

"C'mon...climb aboard

see how the new '15' beats the tracks off anything in its hp class"

"We want you to have first crack at this new workhorse that'll run rings around anything in its hp class—for the dirt it can 'doze, the bucks it can save, the aches it can end.

"It's the new International TD-15, and we guarantee it can show you in only 15 minutes why it heads up its hp class—and what that means to you in money in the bank!

"We'll show you how and why this new '15' can pick up and 'run' with loads that make other rigs sit and 'spin their tracks.'

"We'll show you 1961 operating ease, reliability, and speed—that can add up to a big bundle of cold cash in a season's run.

"We'll show you get-up-and-go that cuts 'dead-heading' back-up time as it's never been cut before—with the 6-speed, full-reverse transmission, and Shuttle-Bar direction changing.

"We'll prove to you—in your own language—that the new TD-15 can make you far more money, for more years, than anything in its horsepower class.

"C'mon in now and spend 15 minutes on a new '15'! Or call us for a demonstration on your job. See for yourself how it's tailored to your operation."

"Start the new '15's' 6-cylinder Diesel engine with push-button ease—see how you save warm-up minutes with International's famous gasoline-conversion starting. Compare the positive engine temperature control you get with pressure-type cooling and reserve capacity radiation."

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International Harvester Co.,
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A COMPLETE POWER PACKAGE

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Beam driven chemical injector

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Air or gas driven chemical injector

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Variable volume electrically driven injector — 0 to 7000 psi — .5 to 12.75 GPH

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6 to 60 GPH glycol pump, glycol and gas powered

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UTILITY PUMP
air or gas powered for construction, marine, industrial and petroleum uses.

• **TRIPLEX PUMP**
Motor, engine or turbine driven — to 5 GPM @ 600 psi

Whatever your pumping or injection needs check first with Texsteam, known for more than a quarter of a century as producers of economical, dependable and precision-made equipment. Write for complete details.

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under conditions of extreme heat or cold, heavy dust, or sand. They can furnish heat at rated from 10 to 100 M.B.t.u. per minute in free flowing air at temperatures up to 950° F. or compressed air from 90° to 500° F. They can also provide large volumes of compressed air at 30 to 350 psig., with only 10% of conventional equipment weight. The units also can provide high - pressure, high - volume fluid pumping. Source: **Mission Mfg. Co.,** Box 4209, Houston 14, Tex., U.S.A.

Thermoelectric generator powers radio

THE HEAT from a kerosine flame is converted by a new portable thermoelectric generator in sufficient quantity to power a radio. Designed for use as a simple emergency power source, it can be valuable in remote areas where electric power is not available or where battery supplies are limited.

Tradenamed Aztec, the device makes a power source that can be stored for long periods without deterioration or causing corrosion. One pint of kerosine or fuel oil will operate the generator continuously for 24 hours. In the absence of a lamp base or a supply of kerosine, the generator can be heated enough for radio operation by a pair of candles held beneath the generator

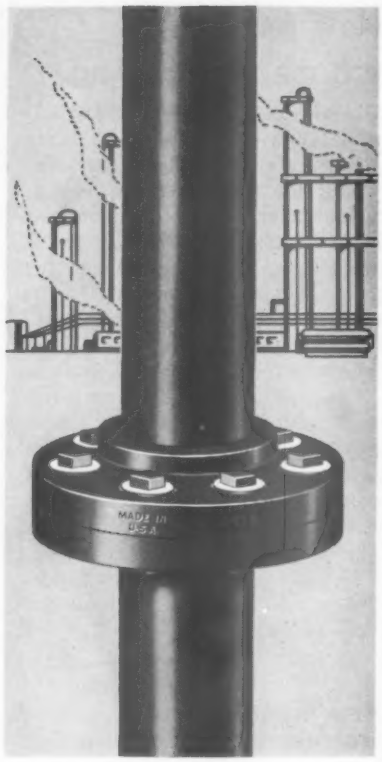
Heat acts on six hermetically sealed thermocouples in the unit to produce a potential of about 0.75 volts and to deliver ½-watt of electrical power to a load. A built-in transistorized converter changes the 0.75-volt output to the 3 to 9 volts required to operate most transistor radios ordinarily powered by batteries. Source: **Minnesota Mining & Mfg. Co.,** 900 Bush Ave., St. Paul 6, Minn., U.S.A.

Expandable drill reamer serves as an underreamer

This new reamer which serves not only as an expandable drill reamer but also as an underreamer operates immediately above the bit as an integral part of the drill string. It reams or underreams simultaneously with the drilling of the hole. Thus it offers a way to reduce trips and rig time when you ream or underream.

The tool will ream or underream the hole up to 5/16 in. larger than the outside diameter of the drill bit as the hole is drilled. At the same time, it stabilizes the bit and drill-collar string to minimize cutting a spiral or helical hole.

As described by the maker, the tool will minimize the hazard of sticking the drill bit because of a spiral hole or wall cake. And it cuts a full round yet smooth hole to obtain improved cementing of liners. Source: **Drilling & Service, Inc.,** 6210 N. Central Expressway, Dallas 6, Tex., U.S.A.



HARRISBURG FLANGES

Among OIL PRODUCERS, SHIP BUILDERS, PIPE FABRICATORS AND THE CHEMICAL INDUSTRY, Harrisburg Steel has maintained a long-standing reputation of high quality and integrity.

Flanges produced by Harrisburg are made to A.S.A. standards. They are available in threaded, butt-welding, slip-on welding, Van Stone and blind types. They are shot-blasted and dip-coat finished with a rust preventative black lacquer. Prompt shipment in small quantities or carload lots.

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REVERSIBLE!

One of many Viking pumping advantages

- Operate equally well in either direction
- Prime themselves fast
- Just 2 moving parts
- Deliver thick or thin liquids
- Smooth, even discharge
- Available in 22 sizes — ½ to 1050 G.P.M.
- Pressures up to 100 P.S.I. with non-lubricating liquids
  ... 200 P.S.I. with lubricating liquids
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AVAILABLE IN
- Iron
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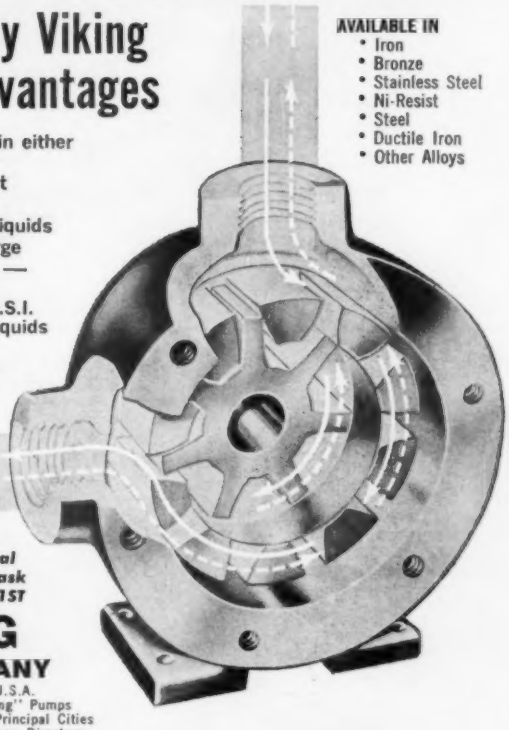
- Ni-Resist
- Steel
- Ductile Iron
- Other Alloys



50 YEARS

For additional information, ask for catalog 61ST

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Koppers Piston Rings are now available in the field in a complete range of materials and a wide selection of types and sizes for every application in the oil and gas industry

For trouble-free performance, lower operating costs, less down-time, select Koppers Piston Rings—choice of many original equipment manufacturers.

Koppers Piston Ring dependability, in even the most rugged applications, is backed with 38 years of experience in manufacturing rings of predictable performance.

If you have a ring problem, consult your Koppers field agent or write: KOPPERS COMPANY, INC., Piston and Sealing Ring Department, 6605 Scott Street, Baltimore 3, Maryland.

Send now for Koppers recommended Piston Ring Set-Ups applicable to the engines which you operate.

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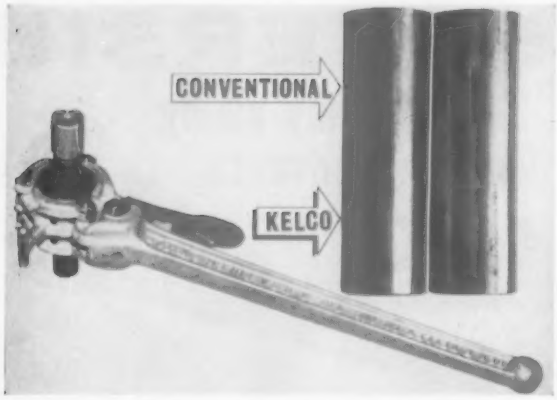

New tong for soft macaroni tubing

TUBING IS NOT DAMAGED with a new tubing tong now being marketed for use with soft macaroni tubing, the maker reports. The illustration shows results of tests made on macaroni tubing using the new Fulgrip tong and a conventional tong. The joint on the left in the illustration was tonged with 800 lb.-ft. of torque, and the one on the right was tonged with 600 lb.-ft.

Made of Amalloy, the tong will meet makeup and breakout torque requirements up to 1,500 lb.-ft., the maker says. With 1-in. dies, it weighs 10½ lb. With 1½-in. dies, it weighs 9½ lb. The tong comes with dies for 1, 1¼, and 1½-in. tubing or couplings. Source: **Ben F. Kelley Co., Inc.,** 18 S. Madison, Tulsa, Okla., U.S.A.

●

New heater for storage tanks

Cast steel headers provide high corrosion allowances and effective condensate drainage on a new storage tank heater that has been developed. The Model TFS-816 heater uses finned tubes to give 12 times more heating surface per foot of length than bare pipe.

Compared with bare pipe, this feature transfers more heat to the tank fluid at a lower skin temperature, which helps prevent coking on the tubes, polymerization, or product discoloration. The finned tubes are 1½-in. IPS Schedule 80 seamless pipe, with 36 fins permanently bonded to each tube.

Each heater gives 275 sq. ft. of heating surface, displaces 1¼ cu. ft. of fluid, weighs about 400 lb., and has a pressure rating of 600 psi. at 650° F. The rapid heat flow from the tube to the fin causes thermal siphon action in the tank, dispersing the heat throughout the tank and preventing stratification or sedimentation by agitation of the fluid. Source: **Brown Fintube Co.,** 300 Huron, Elyria, Ohio, U.S.A.

TANK CLEANER is made by Para-Lax Corp., Tulsa, Okla., who also make Para-Lax paraffin solvent. Unit comprises a Robbins & Myers Moyno pump and a 30-hp Wisconsin Engine tailored for the job.
portable
WISCONSIN-
powered unit

cleans tanks *on-stream*... and recovers good oil from settlings

This unique pumping unit does both jobs at the same time — and without shut-downs. Its easy mobility adds more savings.

The rig pumps a special solvent to the bottom of the tank for dissolving paraffin and other settlings. A jet-action rake speeds the process by providing wide-area contact—and by pumping up to 250 bph of solvent at 150 psi for proper agitation to make the viscous bottoms pumpable.

The "cut" fluid is circulated and heated, if necessary, until all the good oil has been recovered. The pump also removes nails, nuts, bolts, and other matter.

Safe all-weather power is supplied by an air-cooled VH4D Wisconsin, complete with explosion-proof ignition and muffler. Its high torque prevents stalling under changing loads. And Stellite exhaust valves and inserts plus positive rotators *extend valve life up to 500%!*

Let us tailor the Wisconsin-powered utility unit for your job. Engine sizes from 3 to 56 hp — available with custom-engineered modifications. Write for more information.

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Oil Field Distributors for Wisconsin Engines and all types of Utility Units

World's Largest Builders of Heavy-Duty Air-Cooled Engines

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YOU CAN COUNT ON POWELL VALVES

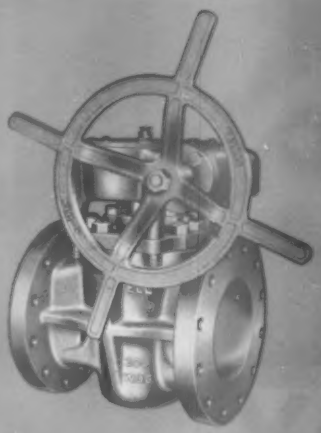
Performance proves it, year after year—you can count on Powell Valves to help you solve the toughest flow control problems found in refineries and petrochemical plants.

This truly dependable performance results from many things—among them Powell's engineering know-how, accumulated during 115 years of valve manufacturing . . . and skillful use of the widest selection of quality materials—bronze, iron, steel and alloys.

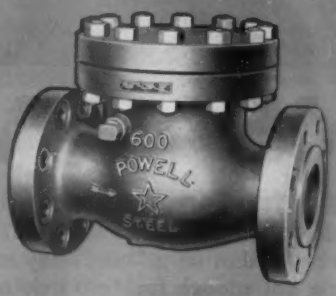
Then, too, you can count on getting the Powell Valve you need, when you need it. That's because Powell maintains a network of distributors backed up by factory inventories, warehoused "ready to go."

Get the full story from your nearby Powell Valve Distributor, or write us direct.

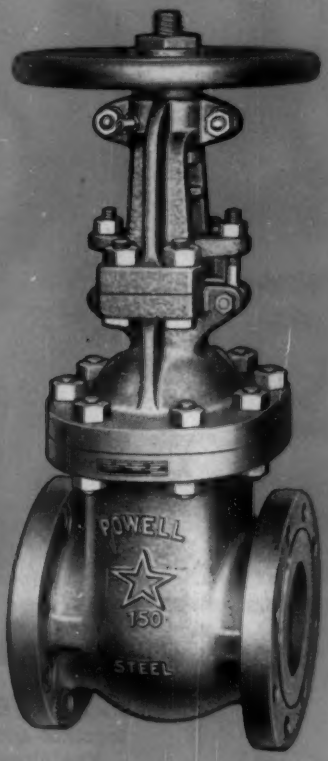
300-pound Stainless Steel Gate Valve—Fig. 2467. Bolted flanged yoke-bonnet. Outside screw rising stem. Fully guided solid or split wedges, integral seats. Sizes, ¼" through 2". Also designed in larger sizes, 2½" through 12".



200-pound W.O.G. Semi-Steel Lubricated Plug Valve—Fig. 2207G. Bolted gland type. Worm gear operated. Sizes, 4" through 12". Also available with spur gearing.



600-pound Steel Horizontal Swing Check Valve—Fig. 6061, flanged ends. Bolted cap. Renewable disc and seat rings. Has full flow area when valve is fully open. Sizes, ½" through 8".



150-pound Steel Gate Valve —Fig. 1503, flanged ends. Bolted flanged yoke-bonnet. Outside screw rising stem. Interchangeable solid or split wedges, renewable seats. Sizes, ½" through 30".

115th year of manufacturing industrial valves for the free world

POWELL DEPENDABLE VALVES

THE WM. POWELL COMPANY CINCINNATI 22, OHIO

TEXANS SAY...

...it gets so hot in Texas that pipeliners just butt the pipe together and it welds itself. Or so they say.

The photo above was shot on a "cool" day in southwestern Texas. It was only 104°, not quite hot enough for "sun-welding." But the welders had the next best thing—easy-working Bethlehem electric resistance-weld pipe. It *always* takes a good weld. And it's made good and round, and with the proper bevel so that it will line up quickly.

ERW pipe in lengths up to 62 ft . . . sizes 5-9/16 to 16 in. OD

We make ERW line pipe in 62-ft lengths and in sizes from 5-9/16 to 16 in. OD. Meets API 5L, Grades A or B, or API 5LX, Grades X42, X46, or X52 specifications. Just like our continuous buttweld line pipe, it's made at our Sparrows Point, Md., plant, from where we ship it all over the world.

BETHLEHEM STEEL

It gets hot in Pa., too! The scene above is southeastern Pennsylvania in mid-summer, and the day was a real sizzler. The crew welding this Bethlehem 36-in. pipe appreciated even the scant shade of an umbrella.

EFW pipe in sizes 18 to 42 in. OD

Bethlehem makes electric fusion-weld, expanded line pipe from 18 in. up to 42-in. OD. What's more, we can make it with ¾-in. walls.

We make large-OD, high-test line pipe in 40-ft. lengths, meeting all applicable API standards and lined at the mill if desired. We can also produce fabricated pipe to the above sizes using high-strength, alloy steel to achieve the desired physical properties with relatively thin walls. Substantial savings are possible.

For good, sound line pipe for any kind of pipeline, check with Bethlehem. Our nearest sales office can give you all the details.

Steel
for Strength
. . . Economy
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BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

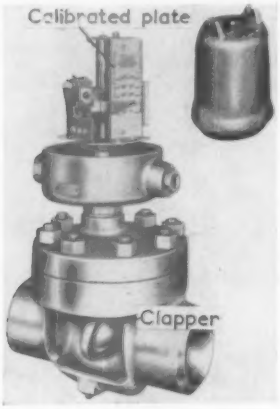
Export Sales: Bethlehem Steel Export Corporation

Capacitor for electric field pumping installations

Ratings from 2 through 6 kva. are available in a line of 830-volt outdoor capacitors recently put on the market for oil-field pumping units. As described by the manufacturer, the capacitors will provide power factor improvement for the higher-voltage motors now being used for electrified pumping. Applied on the load side of the motor starter, they do not require a separate switch.

An aluminum case is used to house the capacitor and protect it from corrosion and the weather. Mounting flanges on the case let you install it on any flat surface without using brackets.

The maker reports that the capacitors have internal discharge resistors that reduce the residual voltage to 50 volts crest in less than a minute after the unit is disconnected from the circuit. Source: **Westinghouse Electric Corp.**, P. O. Box 2099, Pittsburgh 30, Pa., U.S.A.



Check-valve, flow-control combined in new unit

The advantages of a check valve and those of flow control are combined in a new device which can handle most any liquid at any pressure or temperature. A valve disk is magnetically coupled to a switch mechanism. The switch mechanism has mercury-to-mercury switch contacts.

The package can be used to remotely signal flow or no flow through the valve. It can also serve as an interlock safety control in startup or shutdown of equipment. The indicator on top of the Model

Target

Versatility-Economy

Now you can reduce costs and simplify valve specifying by using the highly versatile and economical Norriseal Wafer Type Butterfly Valve. Designed for working pressures to 150 psi, the Norriseal Valve features removable and interchangeable rubber and metal seats . . . takes up less line space . . . can be easily and quickly removed for "on-the-spot" maintenance . . . is field repairable. The wide selection of trim available qualifies the Norriseal Valve for use in many oil field and industrial applications.

Write for prices and complete literature today!

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P. O. BOX 1739 • TULSA, OKLA.

BRANCHES: Great Bend, Houston, Kilgore, Odessa, Wichita Falls, Salem, Casper, Farmington

FCV unit indicates the valve-disk position, from open to closed. It can be adjusted in the field, and it gives a signal at any preset position of the valve disk. External adjustment can be from 10° to 50°. This can be made without isolating the valve from the line. Source: **Magnetrol, Inc.,** 5300 Belmont Rd., Downers Grove, Ill., U.S.A.

•

Plastic linings developed for oil-field tubular goods

One of the new linings (TLC-44) is a phenolic resin which reportedly is designed specially to provide flexibility and resistance to salt-water disposal conditions. It is a baked-on multiple film with a high-build lining of 6 to 8 mil.

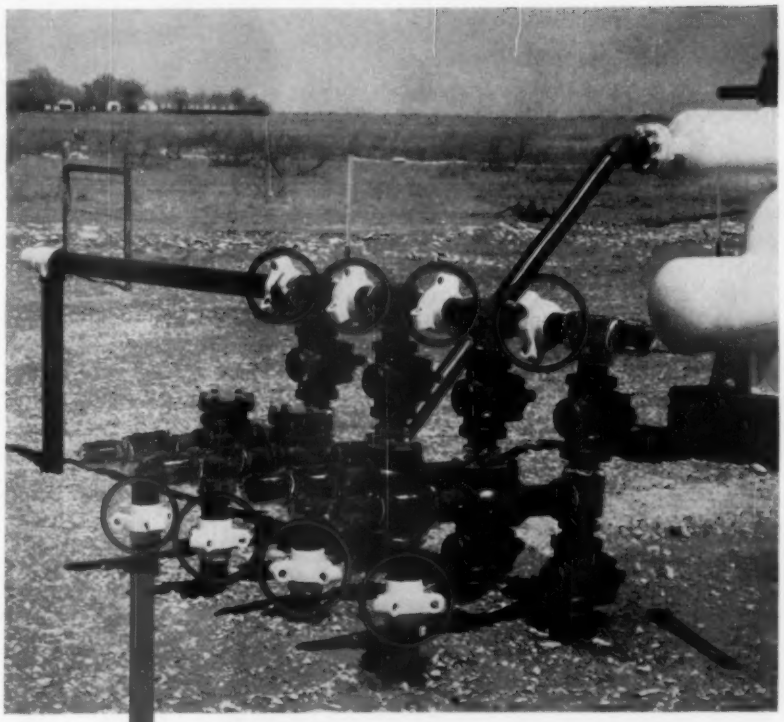
The other lining (TLC-77) is designed for the high temperature conditions found in deep oil and gas wells. It has a baked-on multiple-layer thickness of 4½ to 5 mils which is claimed to provide excellent chemical resistance with good rigid film integrity. Recommended temperature limitation is reportedly 400° F. Source: **Tubular Lining Corp.,** P. O. Box 20015, Houston 25, Tex., U.S.A.

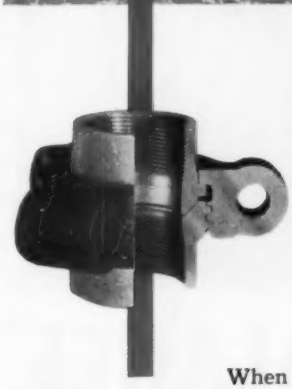
•

Piston uses O-ring seal to prevent washout

The O-ring seal is placed in the bore of the rubber and held under pressure by a retainer plate on the Moly-0 slush-pump piston now on the market. A fabric backing strengthens the piston rubber and gives it added resistance to compression and tensile stresses

The piston hub is machined from forged steel which has been hardened on all surfaces. It can be used repeatedly with new rubbers. Source: **Harrisburg, Inc.,** Box 1053, Houston, Tex., U.S.A.





The WECO WAY Is The BETTER WAY

When you're making up field headers and manifolds; setting separators, heaters, treaters; connecting tank batteries and making other field installations, the unions to use are WECO.

The precision pipe threads make-up easy and are leakproof. The acme threads on sub and nut make-up fast. The ball and cone seat is a positive leakpoof seal. The three lug Fig. 100 (above) can be made up with a bar or hammer.

Standardize with WECO on all your production hook-ups and field connections to simplify installation and save money on subsequent changes or additions.

WECO Unions available from supply stores everywhere.

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U-4-61 fmc

Differential refractometer

Control of liquid process streams based on very small changes in the index of refraction of the stream compared to a sealed reference standard or a flowing reference standard is possible with a new process differential refractometer, the developer reports.

The instrument reportedly can measure full-scale changes in refractive index as small as 0.00005 with a stability better than 1% of

full scale in 24 hours. Sensitivity is 0.5% of full scale.

The flowing reference cell is claimed to provide true, accurate blending of two streams though one stream varies in composition. In this cell, one stream flows through the reference cell continuously. The same stream plus the addition of the blended material flows through the sample cell.

The sensitivity of the instrument is said to be high enough to permit measurement of impurities in parts per million in final product streams. In its operation, the instrument measures the amount a light beam bends when the refractive index of the liquid sample changes. Source: **Waters Associates,** 45 Franklin, Framingham, Mass., U.S.A.

●

Strong rotary drilling hose

A new rotary drilling hose has been put out for deep drilling where high pressures, high temperatures, and abrasion subject hose to rough service conditions. The MC-560 hose has four layers of single-strand steel wire as a reinforcement. A blanket of rubber and fabric protects the wires and keeps them in place.

A built-in coupling on the hose has no protruding parts to snag. The secondary carcass and cover of the hose are both flush with and bonded to the coupling body. At each end of the hose a strong cable is spirally wound for 36 in. to give the hose extra strength. The hose comes in three sizes: 2½, 3, and 3½ in. Source: **Hewitt - Robbins,** Stamford, Conn., U.S.A.

●

Jet business plane to be put in production

Oil-industry executives can travel at speeds of over 500 m.p.h. in a new twin-engine jet aircraft that has recently been introduced. Production deliveries of the craft are to begin in the third quarter of 1963.

The Model 1121 plane will retain the short-field capability of the maker's current craft, and it will be able to operate from those community airports throughout the world and the United States that presently are served by present business aircraft, according to the manufacturer. Source: **Aero Commander, Inc.,** Bethany, Okla., U.S.A.

CORRECT BALANCE

. . . easily and exactly!

For peak efficiency a well must be correctly balanced. The deeper the well the more important correct counterbalance becomes.

Even small changes in well conditions can result in power waste and unnecessary wear and damage if a pumping well is not properly balanced.

Correcting the adjustment on this JENSEN Rotary Balanced JACK is such a simple one-man job there is no excuse for any well to ever be improperly balanced—whether deep or shallow.

Get the money-saving facts on JENSEN JACKS before you equip that next well.

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1961-62 DIRECTORY

OF PLANTS AND PERSONNEL

- CRUDE-OIL REFINERIES
- GAS PROCESSING PLANTS
- PETROCHEMICAL PLANTS

This new edition of The Journal's Annual Directory brings you the results of recent surveys of the processing side of the oil and gas industry. The surveys cover installations in the U. S., Canada, Western Europe, and the Middle East. It brings you the facts.

- A statistical summary arranged alphabetically by state and company which gives you the names, capacities, and processes.
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And the finest quality steel tubing today carries the Ⓢ and Ⓨ symbols of Yawata Steel Tube Co., Ltd. (Formerly Nippon Tokushu Steel Tube Co., Ltd. with Ⓢ NTK mark), an important subsidiary of the giant Yawata Iron & Steel Co., Ltd. The main products in Pipe & Tubing (seamless or welded) include:

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What's NEW

... in literature

Data charts of welding electrodes

The charts present information on comparative bronze electrodes, melting rates and efficiencies, electrode and filler-rod specifications, and recommended welding currents for various welding procedures. The charts also describe the maker's weldrod color code, deposit density, number of electrodes per pound, and feet per pound of bare rod and wire. Source: **Ampco Metal, Inc.,** Box 2004, Milwaukee 1, Wis., U.S.A.

Is undercut pin superior to conventional API sucker pin?

"Absolutely yes!" according to a new eight-page pamphlet, obtainable free upon request. The literature states that by turning the sucker-rod pin between the last full thread and the seating shoulder to a diameter slightly less than the minor diameter of the threads, the most critical fatigue point is lengthened. Thus, its capacity to absorb the alternating stresses of the pump cycle becomes greater. The pamphlet presents drawings of cut-thread and rolled-thread grain structures in an effort to show why rolled threads improve fatigue resistance of threads on undercut or conventional API sucker-rod pins. Source: **W. C. Norris Div., Dover Corp.,** Box 1739, Tulsa, Okla., U.S.A.

Solenoid-valve selector chart for valves

Bulletin SL-1 contains specific data regarding size, pressure, temperature, coil type, special features, and assemblies. The back cover of the four-page literature shows flow factors used for quick and accurate valve sizing. Source: **J. D. Gould Co.,** 4707 Massachusetts Ave., Indianapolis 18, Ind., U.S.A.

Portable industrial lighting molded to cable

A new 12-page publication offers a selector chart of extensions, feeders, lights, line lights, mounting clamps, distribution centers, and miscellaneous parts. Bulletin B76 includes pictures and specifications on various components, including connector styles, lamps and sockets, hand lamps, power outlet receptacles, vaporproof distribution boxes, and mounting clamps. Source: **Electrical Products Div., Joy Mfg. Co.,** 1201 Macklind Ave., St. Louis 10, Mo., U.S.A.

Teflon V-rings

Catalog V-8 contains photographs while offering data on design, economy, applications, advantages, and space requirements. The eight-page publication includes a full-page discussion on the economics of Teflon V-rings, along with another full page of typical assemblies for Teflon and Tefloam V-ring packings. Source: **Halogen Insulator & Seal Corp.,** 10121 Franklin Ave., Franklin Park, Ill., U.S.A.

Internal-diameter gage

This instrument, when used with its component part—a gage setting fixture—requires no masters, rings, or setting blocks. According to a new six-page folder. the instrument

at last—

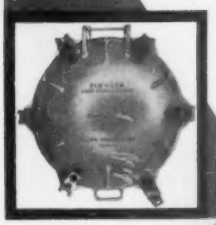
A MANWAY COVER THAT REALLY DOES THE JOB!

Enardo's brand new 7620 Cam-Loc Quick Opening Manway Cover has all the ingredients — it's big enough (20 inches) to provide easy access, versatile enough to handle a variety of applications, positive sealing yet opened in seconds with the time-saving Cam-Loc.

The 7620 cover is available in either aluminum or Meehanite and has been used effectively on lease vessels, tank cars, tank trucks and all kinds of vessels with pressures up to 50 psi. It has been tested with many types of fluids and can even handle bulk cement and dry bulk solids such as grain and flour.

The 7620-SA1 base is made of SA-283C, grade C, steel and is coded according to ASME specifications. Partial Data Reports can be furnished on each cover so the vessel manufacturer can obtain ASME code.

Call, write or wire Enardo Manufacturing Co. for more information.



ENARDO manufacturing co.

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is designed for setting any hole diameter, measuring exact hole size, and part-to-part size duplication. Source: **Sunnen Service Corp.,** 7900 Manchester, St. Louis 17, Mo., U.S.A.

Tubular gage-glass assemblies

New, illustrated Data Unit 399 gives complete instructions for installation, operation, and maintenance of the tubular gage-glass assemblies. Included is a valve line drawing which shows component parts. Source: **Jerguson Gage & Valve Co.,** Adams St., Burlington, Mass., U.S.A.

Original high-pressure fog effective in fighting fires

This new, 16-page catalog—entitled "Industrial Fire Fighters"—is now being offered free. Listed are complete specifications and performance features for all the maker's in-plant fire fighters including stationary, mobile, and skid-mounted equipment. Source: **John Bean Div., Food Machinery & Chemical Corp.,** Lansing 4, Mich., U.S.A.

Brochure outlines latest 1,500-hp. draw works

This eight-page literature details rig features with cutaway views of brakes, transmission, and main drum. It gives complete specifications and a power flow diagram. Of particular interest is a torsion-bar equalizer on the brakes, said to assure balanced braking force on the brake rims, yet permit brake bands to be adjusted individually. The draw works is designed for drilling in the 10,000 to 20,000-ft. range. Source: **Gardner-Denver Co.,** 100 Williamson St., Quincy, Ill., U.S.A.

Motors, generators, and controls

Newly revised 48-page Bulletin E100P presents theoretical and practical features of common types of d.c. and a.c. motors, generators, and control equipment. The publication is intended as an aid to familiarize those of interest with electrical terminology and phenomena. Text is illustrated with electrical rotating machines and allied equipment. Source: **Fairbanks, Morse & Co., Electrical Div.,** 303 N. Henderson, Freeport, Ill., U.S.A.

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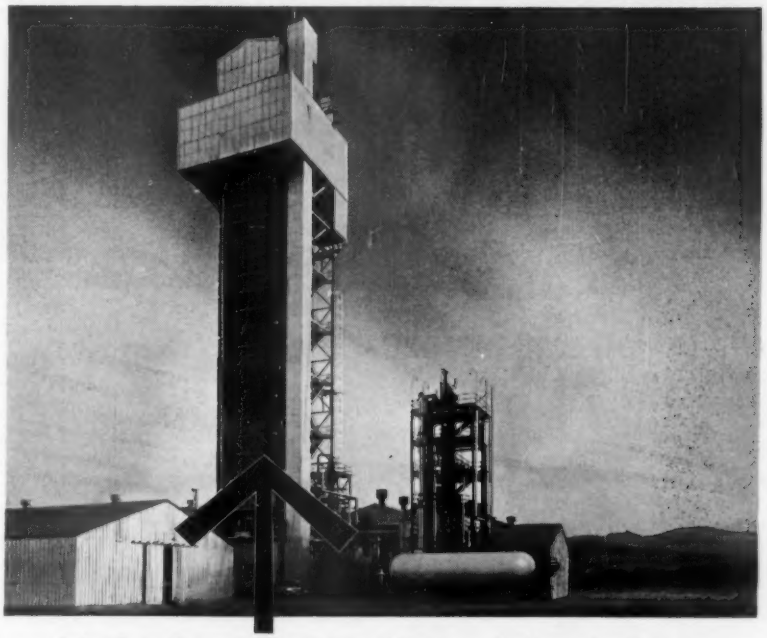

All-aluminum construction resists corrosion, weatherproofs thermal insulation in Spencer Chemical prilling tower

This 180-ft, all-aluminum, urea prilling tower, operated by Spencer Chemical Co., Henderson, Ky., was built by Mississippi Valley Structural Steel Co., St. Louis, Mo. To ensure uninterrupted, corrosion-free service, plant designers used Alcoa® Aluminum throughout—frame, walls, bolts, piping, fittings, connections and fasteners. Aluminum sheathing weatherproofs thermal insulation on tower, heat exchangers and piping. Please send the coupon for more information about Alcoa Aluminum's unique advantages.

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- ☐ 68-10460 *Process Industries Applications of Alcoa Aluminum*
- ☐ 03-19122 *Alcoa Structural Handbook*
- ☐ 42-20849 *Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres*

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▶▶▶ Equipment Men Notes

New publication for land men ... has been announced by Peter Verhalen, publisher of the independent monthly "Farmout Review." Verhalen was formerly Mid-Continent division land man for Apache Corp., Tulsa. Available on a subscription basis, the publication carries listings of proposed farmouts, acreage to be leased, and producing properties for sale.

These prospects are submitted for publication by interested sellers. The publication makes contact between sellers and buyers, while keeping all listings confidential except to subscribers.

J&L Supply assigns four ... members of its field sales force, according to W. L. Wolfe, vice president of sales. H. B. Carruth, Jr., formerly assigned to the Houston store, has become a salesman assigned to Longview, Tex. B. E. Irby, salesman at Longview, has been shifted to Ruston, La., in the same capacity. J. B. Williams, salesman at El Dorado, Ark., has been appointed salesman-supervisor and assigned to Mexia, Tex. A. A. Bell, previously assigned to the Corpus Christi store, has become a salesman at Luling, Tex.

William C. Grimes is boosted ... to senior field service engineer for the Scientific & Process Instruments Division of Beckman Instruments, Inc. A Beckman employe since 1957, he most recently was field service engineer for the division's western region. With headquarters at the company's home plant in Fullerton, Calif., Grimes will handle the installation of infrared instruments and allied equipment in all parts of the country.

National Supply Division moves ... administration functions of its oil-field-sales department to Dallas. About 35 employes from the general offices in Pittsburgh were involved in the transfer. Executive offices of National Supply, its staff departments, and the general sales headquarters of its tubular department, will remain in Pittsburgh.

T. B. Herndon

Headed by T. B. Herndon, manager of oil-field sales, the group that moved includes sales managers for drilling, production, and merchandising products; the manager of inventory control; the manager of the general sales office; the purchasing agent for merchandising products; and members of their staffs.

Ingersoll-Rand adds 4 branches ... to provide faster service to customers in New England and midwestern areas. The new branches are located in Hartford, Conn., Moline, Ill., Midland, Tex., and Indianapolis. Branch managers, respectively, are: T. A. Holmes, R. F. Korsmo, C. J. Rajnus, and D. D. Barta.

B. D. Richardson is branch mgr. ... of Houston Engine & Pump Co. at Harvey, La., according to Thomas N. Hunt, president of Hunt Tool Co. Richardson was formerly a technician and sales engineer with the Electro-Motive Division of General Motors Corp.

K. R. Geist is general manager ... of the newly formed special products department, Allis-Chalmers Mfg. Co., announces W. G. Scholl, executive vice president. Geist will develop new businesses for the company Products, materials, and processes which will be handled by his department will come principally from the A-C Central Research Division and other of the firm's research and development centers. Geist, a 20-year A-C member, most recently was director of purchases.

P. R. Monaghan assumes post ... as general sales manager of Jefferson Chemical Co., Inc., it was announced by D. L. Griswold, vice president of marketing. At the same time, R. E. Werley, assistant sales manager, was assigned to the company's New York office.

P. R. Monaghan

Monaghan will be located at company headquarters in Houston. He will be charged with direction of domestic and foreign sales forces, long-range planning, and continuous development of the sales organization.

Dynaquip buys pumping-unit line ... from Axelson-Garrett Division of U. S. Industries, Inc. Dynaquip, of Long Beach, has taken over A-G's Hydrax hydraulic pumping-unit line; engineering, sales and service personnel; as well as inventory, warehouse, and service facilities.

All Hydrax units previously sold will now be serviced by Dynaquip from sales and service points at Long Beach, Bakersfield, Odessa, Shreveport, and Casper. The main manufacturing plant is in Long Beach.

WORLD'S LARGEST MAGNETIC FLOWMETER is this 7-ton giant with a 78-in.-diameter metering tube, recently delivered to Union Carbide Chemicals Co.'s plant at Seadrift,Tex. For cost-accounting purposes, the meter will measure the quantity of water being pumped from the chemical plant's cooling-water basins. Built by Fischer & Porter Co., the "mag" meter is 7½-ft. high, 16½-ft. long, and 8¾-ft. wide. It weighs 24 tons when filled with water and has a maximum flow capacity of 450,000 g.p.m., although only one-third of capacity will be used at first. Measuring accuracy is within 1%.

A. H. Quay is marketing director

. . . of Atlas Bradford Co., Houston, shifting from his previous position of director of technical services for all Atlas Bradford divisions—Atlas Pipe Inc., Bradford Supply Co., Hardy-Griffin Engineering Corp., and Universal Inspection & Service Co.

Quay joined the engineering staff of Jones & Laughlin Steel Corp. in 1925. By 1939 he had advanced to chief metallurgical engineer of J&L's Tubular Goods Division. Quay ,started with Tuboscope Co. in 1951 and served as vice president of foreign operations prior to joining Atlas Bradford in May 1960.

Charles E. Lamar is appointed

C. E. Lamar

. . . executive vice president of Southern Pipe Division of U. S. Industries, Inc., announces D. A. Stromsoe, president of the division. Lamar joined Southern Pipe in 1951 as a sales engineer. He became a sales representative the next year and was made assistant sales manager in 1957. In 1959 he was named manager of sales and shortly thereafter became a director of the division. Last January Lamar was appointed vice president of marketing.

Chicago Bridge & Iron elects

. . . H. J. Clarke and S. C. Hamilton as senior vice presidents, and J. T. Horton and M. G. Mitchell as vice presidents. Clarke is now in charge of the company's operating department, following 9 years as vice president of field construction. Hamilton assumes the position of senior vice president of the contracting department. He has been a CB&I director since 1946 and was vice president of sales about 4 years.

Horton, formerly manager of special designs and estimating, has been elected vice president of research. Mitchell's election as a vice presi-

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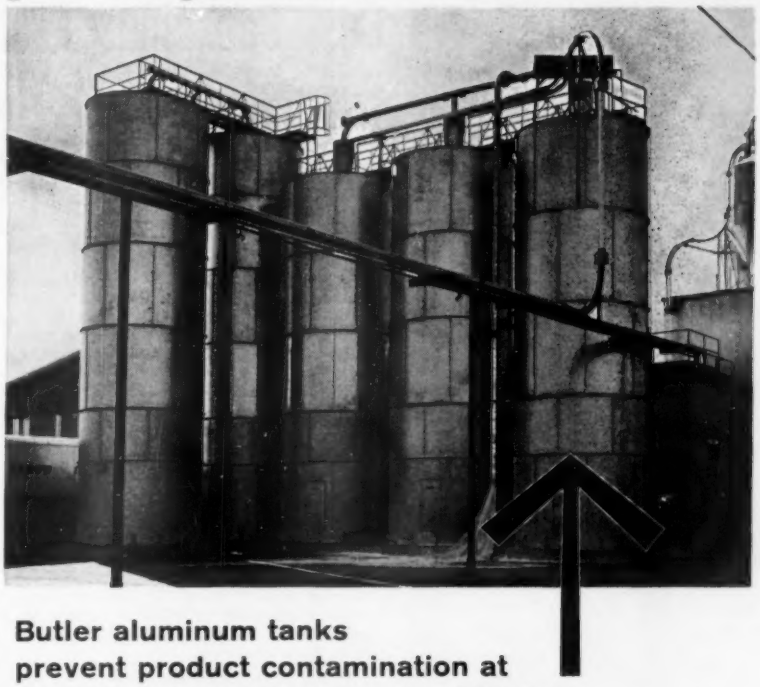

Butler aluminum tanks prevent product contamination at Dow Chemical's Saginaw Bay Division

This aluminum storage installation maintains product purity for the polychemicals department of Dow Chemical Co., Bay City, Mich. Used for polystyrene, polypropylene or polyvinyl chloride, these bolted tanks were fabricated of ALCOA® Aluminum by the Bulk Storage Division of Butler Manufacturing Co., Kansas City, Mo. Many sensitive chemicals and oils are handled today in aluminum to avoid product degradation or decomposition. Moreover, low initial cost and no maintenance make aluminum an economical investment. We'd like to send you more information. Please mail the coupon.

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☐ 68-10460 *Process Industries Applications of Alcoa Aluminum*
☐ 42-20849 *Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres*

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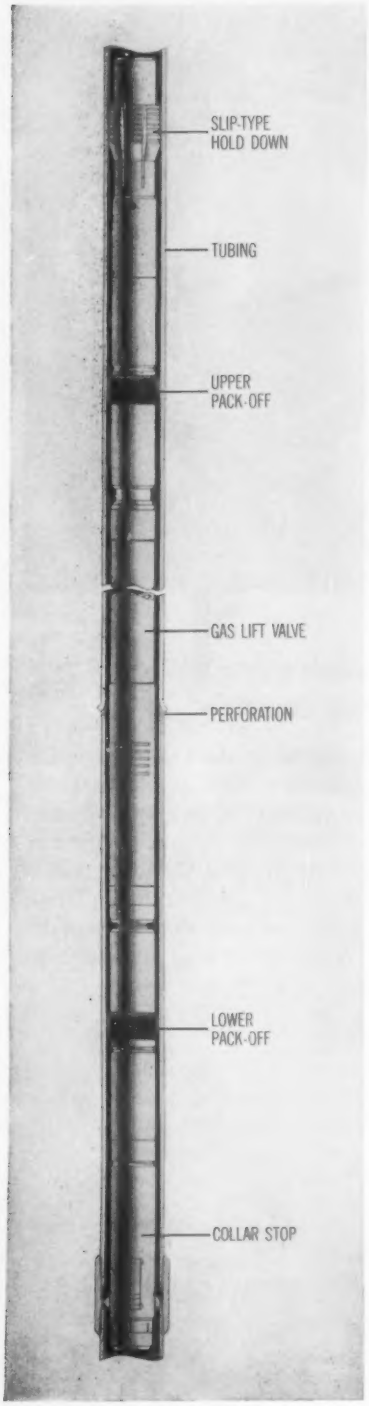
SPECIAL REPORT TO MANAGEMENT

OTIS PRODUCTION NEWS

Volume II, Number 3 **Otis Engineering Corporation • Dallas** *Production Equipment and Services*



Cost-Conscious Producing Companies Endorse Otis All Wire Line Technique Of Converting Wells to Gas Lift

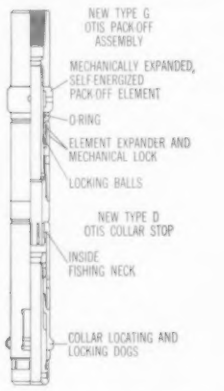
CORPUS CHRISTI—Eliminate the cost of a pulling unit to round-trip tubing when converting a well to gas lift and you can save an impressive amount of money per well. That's what several of the major producing companies in this area discovered when they started using the new Otis "All-Wire-Line" Gas Lift Conversion Technique.

A spokesman for one of these majors recently stated that his company is most enthusiastic about the technique — especially for water locations — because "(1) it's faster, (2) it's less expensive, (3) it's every bit as efficient as other types of installations they have made, and (4) it eliminates the risk of damage to the producing formation from contamination by mud and/or water in the annulus." Another company reported a savings of $60,000 in converting three, readily accessible, land locations.

As an example of how the technique can reduce the cost of a conversion, take a look at the following case history: A 6800-foot well located in approximately three feet of water in the Copano Bay Field ceased to flow naturally and was scheduled to be put on gas lift. In making plans to have the work done, it was discovered the approach canal had filled with silt and sand, which meant an expensive dredging operation would be necessary before a barge-mounted workover unit could be moved onto location; cost of a workover unit would be $1400 per day, and the annulus was loaded with old drilling fluid. Estimated conversion costs were mounting fast. A conference with the Otis Gas Lift Specialist in the area convinced the operator he should try a Type CG Otis Pack-Off Gas Lift Valve installation.

After setting a circulating plug in the tubing at the spot indicated for the lower-most valve, perforating and circulating mud from the annulus, it took the trained Otis Wire Line Specialist only 15½ hours of wire line time to perforate and install five concentric Type C Gas Lift Valves between Type G Otis Pack-Off Assemblies and have the well ready to be put back on production. Eight months following the conversion, the well was still making its allowable in an economical and efficient manner. And to attest to the reliability of the new Type G Otis Pack-Off Assemblies, the well was being produced from the lower-most valve.

Otis Gas Lift and Completion Specialists are interested in helping you find a way to complete and produce your wells in the most efficient manner. The experience these men have accrued throughout the years is yours to draw from when faced with any down well completion or production flow control problem. Use the knowledge these men have to offer and you will find you'll be spending your production dollars more efficiently. For more information on the Type CG Otis Pack-Off Gas Lift Valve, call the Otis office nearest you or write Otis, Dept. 3-W, Box 35206, Dallas 35, Texas. You'll find your Otis specialists ready to help you — anxious to serve you.


NEW TYPE G OTIS PACK-OFF ASSEMBLY
MECHANICALLY EXPANDED, SELF-ENERGIZED PACK-OFF ELEMENT
O-RING
ELEMENT EXPANDER AND MECHANICAL LOCK
LOCKING BALLS
NEW TYPE D OTIS COLLAR STOP
INSIDE FISHING NECK
COLLAR LOCATING AND LOCKING DOGS

Straight through, full opening bore of pack-offs, collar stop, and gas lift valve permits maximum production with minimum turbulence.

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OTIS

Engineering OTIS Corporation

General Offices:

6612 Denton Drive • Dallas, Texas

dent was simultaneous with his appointment as manager of sales. He was advanced from assistant sales manager, a post he held about 16 months.

Chandler Engineering Co. moves

. . . its Tulsa offices and plant from 320 S. Kenosha to its new building at 7707 E. 38th St. The new facility, located on a 5-acre tract, contains 10,800 sq. ft., more than twice as much space as Chandler's previous quarters.

Arthur C. Motl named dist. mgr.

A. C. Motl

. . . of Hazard Wire Rope Division, American Chain & Cable Co., Inc., for sales to the oil industry. He succeeds the retired Harry S. Frady and will headquarter in Houston. Except for a term in military service in 1945, Motl has been with the company since 1938.

William Swan takes over

. . . as western sales manager of Parker Seal Co., according to T. J. McCuistion, vice president. Swan joined Parker Seal in 1956 as a sales engineer covering Dayton, Ohio and the surrounding area. He was advanced to assistant sales manager with headquarters in Culver City, Calif., in June 1960.

The company also announced the appointment of two new distributors for Parker Seal products—Seals & Engineering, Inc., of Rockford, Ill., and Cal-State Seal Co., Garden Grove, Calif.

Dr. Robert Van Nostrand named

. . . by Rogers Geophysical Cos., of Houston, to serve as an executive of Exploration Geophysique Rogers, the firm's operating company in Europe and North Africa. Dr. Van Nostrand will return to France where he lived for the last 3½ years, serving as chief geophysicist for the Society de Prospection

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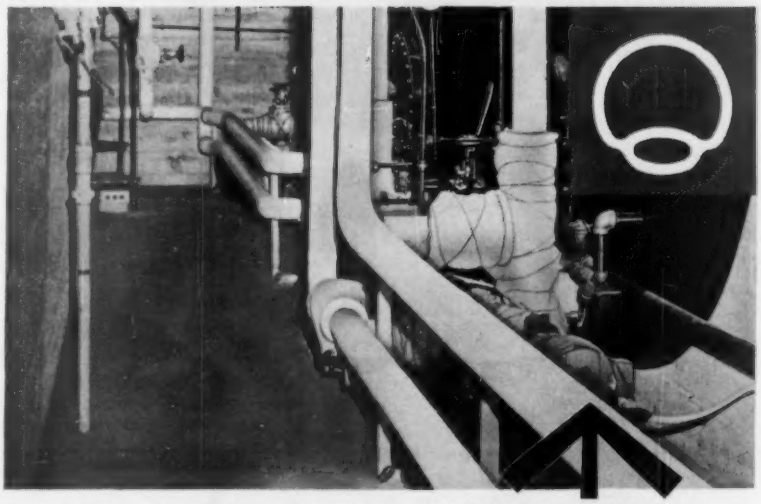

Globe Engineering installed Alcoa Unitrace system for piping paraffin and stearic acid . . . lowered fire hazard, increased production rate

Binney & Smith Inc., Winfield, Kansas, CRAYOLA® crayon manufacturer, recently effected cost savings with Alcoa* Unitrace piping, at one-eighth the quoted cost of stainless. Formerly, block paraffin had been melted slowly in holding pots. Now, Binney & Smith buys paraffin by tank carload, heats and pumps directly to underground storage. Stearic acid is also handled in the same system without discoloration. Fabricated and installed by Globe Engineering Co., Wichita, Kansas, the Unitrace system effected savings in purchasing, insurance, handling and production. Alcoa Unitrace is the light, strong, corrosion-resistant pipe that provides steam and product passages in a single extruded unit —eliminating costly external steam jackets or inefficient tracer tubes. Please send coupon for more information.

*Registered trademark of Aluminum Company of America

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Aluminum Company of America, 826-T Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries.

- ☐ 34-10197 *Aluminum Pipe and Fittings*
- ☐ 34-10418 *Alcoa Unitrace: Combines Piping and Tracing in One Unit*
- ☐ DD- 514 *Alcoa Duotrace Technical Report*
- ☐ 68-10460 *Process Industries Applications of Alcoa Aluminum*

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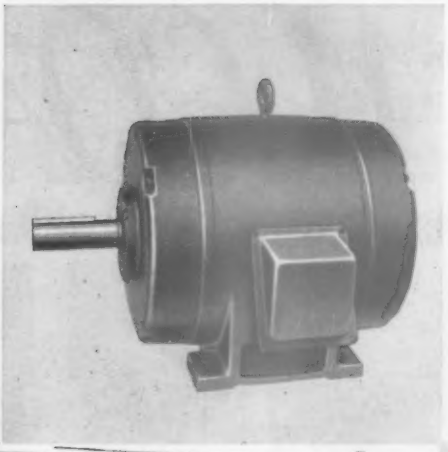
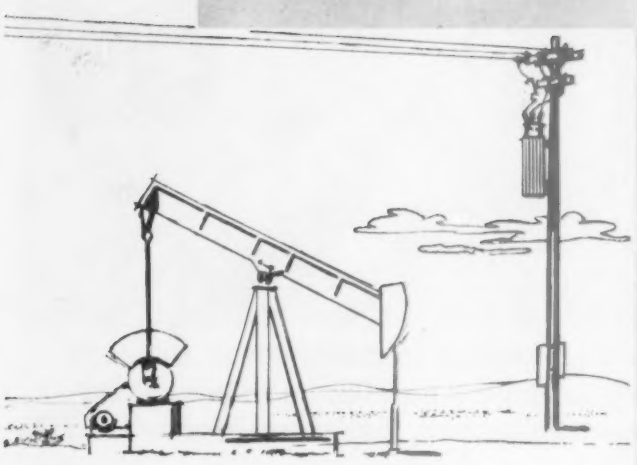
Company_____
Address_____
City_____ Zone_____ State_____



MONEY-SAVING MATES



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...and keep them down. For you can pump better electrically, and this pumping package lets you electrify leases by bringing the high voltage line directly to each well installation, operate each well individually. The lightweight, pole-mounted transformer is matched to its motor load... puts an adequate, dependable power supply close to the load. You get a more orderly and flexible system layout. You save up to 25 percent in materials and labor, eliminate many dead ends, get better lightning protection, and reduce system losses by as much as 65 percent.

The Wagner® motor is engineered for oil well pumping, and only oil well pumping. Nothing else. Because it is designed with high torque and high slip for this specific job, the motor consumes fewer kilowatts per barrel pumped... saves in initial investment and in operating costs. Built in ratings of 5 hp and larger.

Your Wagner Field Engineer can give you the complete story of this cost-cutting pumping package, and help you plan oil well pumping, gathering and water-flooding systems. Call him now, or write for Bulletin EU-426A.

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et Exploitations Petroliers en Alsace. His headquarters will be in Paris.

He has previously been associated with Magnolia Petroleum Co.'s field research lab, doing research in applied geophysics; and with Mobil Overseas Oil Co., assigned in Portugal and France.

"1961 Chief Roughneck" named

...at a recent luncheon meeting of the Texas Independent Producers' Royalty Owners' Association convention in Midland, Tex. Johnny Mitchell, president of Jade Oil Co. and vice chairman of the firm Christie, Mitchell & Mitchell, won the annual award sponsored by Lone Star Steel Co. He was selected by an anonymous committee of prominent oil men in the Southwest.

Johnny Mitchell

Mitchell received a plaque which read, "In Recognition of Rough and Ready Service in the Field." It signifies that he has contributed greatly toward America's leadership in oil and gas, that he has rendered rough and ready service in the field, and has achieved a place of honor in the industry.

Tinker & Rasor announces

...the appointment of D. R. Shannon Co., Seattle, as distributor for electronic testing equipment throughout the northwestern states and Alaska.

INTERNATIONAL GUESTS at the recent meeting of the Los Angeles Chapter of Nomads were, left to right, front row: Earl R. Hughes, Iraq Petroleum Co., Iraq; Frank E. Redd, Dhofar Cities Service, Arabia; and Hugh D. O'Neil, Petrobras, Brazil. In the back row are Cal Parker, Santa Fe Drilling, Burma; Albert Jensen, Drilexco, Portuguese Guina; and William M. Hendricks, ex K & C, London.

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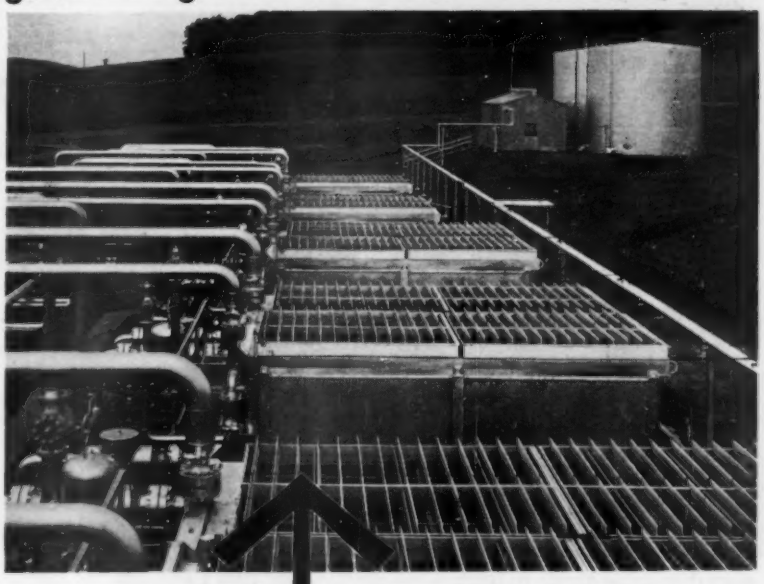

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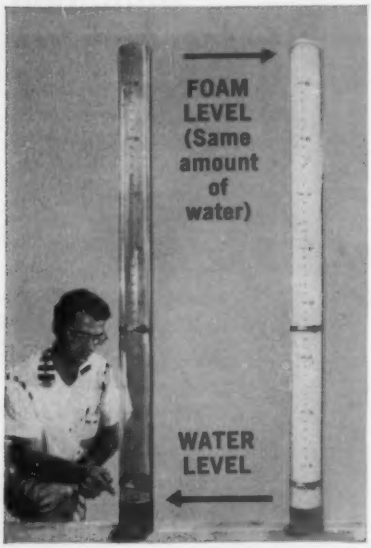
efficient foaming agents– to remove fluids from wells



Dowell foaming agents are designed to cause fluids to foam when aerated by gas or air.

When foaming occurs, fluid density is reduced and well unloading is simplified.

Foaming agents have been used successfully to unload gas wells and oil wells that produce some gas. Produced water or oil—as well as spent acid or fracturing fluids used for stimulation—have been unloaded. Usually, formation energy has been sufficient to unload the fluid. In instances where swabbing was required, swabbing time was reduced to a minimum.

Foaming agents have also been used to unload produced water from wells during air drilling operations.

Dowell foaming agents are offered in three types. G-2 is a water-soluble liquid; G-4 is an oil- and water-soluble liquid; G-5 is a water-soluble stick. All are available from any Dowell station.

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HERE'S THE DEEPEST projected drilling well in Oklahoma—Continental Oil et al. 1 North Corn unit in Washita County. It will be the second-deepest test in the state if it reaches proposed depth of 22,000 ft. State's deepest was Shell 5 Rumberger, which went to 24,002 ft. in 1959. Visitors at the site are a group of executives on a field trip sponsored by the National Bank of Tulsa for its board of directors and guests. Of particular note is the huge motorized mobile crane used to speed rigging up and tearing down on the big rig. A 50-ton crane owned by Bill Hodges Trucking & Crane Co., Tulsa, used a special gondola for field-trip visitors. The crane, largest self-propelled unit of this type west of the Mississippi, provided the guests with elevator service.

Wave of deep drilling permeates western Oklahoma

THERE IS MORE wildcat activity in western Oklahoma than in any other area in the world. A broad statement? You bet it is—and true, too, if you consider the great number of deep tests, the total amount of dollars spent, and the concentration of drilling in both area and time.

Here's why: In the Anadarko basin there are approximately 18 tests now drilling or locations staked for projected depths between 15,000 and 22,000 ft. The flurry of deep drilling is largely due to the fact that producing formations have been found at these depths while still other known potential pays lie still deeper. The entire sedimentary section in the Anadarko basin varies between 18,000 and 30,000 ft. Theoretically, a single deep hole in the

basin could penetrate all the potentially producing rocks in the state.

It's not as much as a long shot as it appears. The deeper the test, the more possibility of getting multiple pays. Although the costs of drilling and completing these wells soar, so do the returns. For example, the cost of drilling and completing five Hunton wells in North Custer field in Custer County was $500,000 each. The discovery well which went to 17,000 ft. had an initial potential of 95 M.M.c.f.d. The potential value of the 640-acre tract is estimated at $12,000,000, a 24-to-1 return on the investment.

And the deep-drilling equipment is expensive. Take the Continental Oil et al. 1 North Corn unit (pictured left). This Washita County venture is in 19-11n-14w, about 7 miles south of the town of Weatherford, Okla., and has a projected depth of 22,000 ft.

Contractor is Parker Drilling Co. of Tulsa and its rig No. 66 on the site is capable of drilling to 28,000 ft. has 2,500 hp. and cost approximately $1 million. The 136-ft. hurricane-style derrick resting on a 26-ft. substructure has a 1-million-pound-plus capacity. Below the derrick floor, the huge blowout-preventer equipment has a value of over $100,000. The draw works on the rig is a National 130.

Continental, as the operator, has 12 partners: Whitehall Oil Co.; R. A. Hefner, Jr.; Tidewater Oil Co.; Sunray Mid-Continent Oil Co.; K. A. Ellison; Sun Oil Co.; Texaco Inc.; R. L. Parker; H. H. Hurd; Roy Wood; J. S. Anderson, Jr.; and R. S. Bowers, Jr.

How did this well come to be drilled? In addition to the $2.2 million it is expected take to drill this well, there are other costs to consider. In 1946, Continental began a reconnaissance seismic survey in the deep part of the Anadarko basin. More than 210 miles of line were shot. The money it took to equip and pay these crews was pumped into the economy of western Oklahoma. A rough estimate of the costs is that about $400 a day was spent during the shooting period.

Additional investment was made in the area between 1949 and 1954 when large lease acquisitions were made. The North Corn unit involves an area of more than 11,000 acres.

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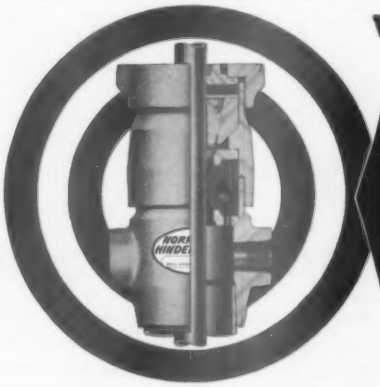

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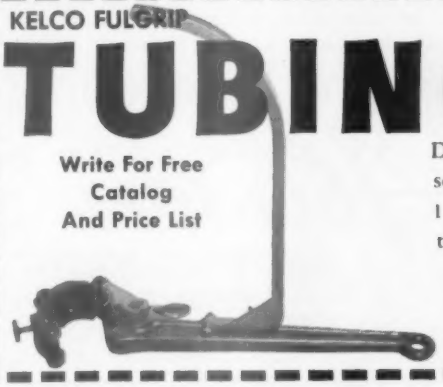

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That's the big reason this Borger, Texas, company replaced stick shifts with TORQMATIC in all 7 of their units working the Borger-Pampa-Perryton area.

Ever since these TORQMATIC replacements were installed, these units have been doing a smoother, easier-to-control job. Operations have been 20% faster. Yet operators now require virtually no job-training–another big saving to Producers Chemical.

And that isn't all. With "smoother than steam" TORQMATIC DRIVES, all 7 units log far less down-time. That in itself is a big plus to any fracturing operation. But maintenance costs have also been cut – by a full 25%. It's easy to see why Producers Chemical is planning to TORQMATIC equip still another unit soon.

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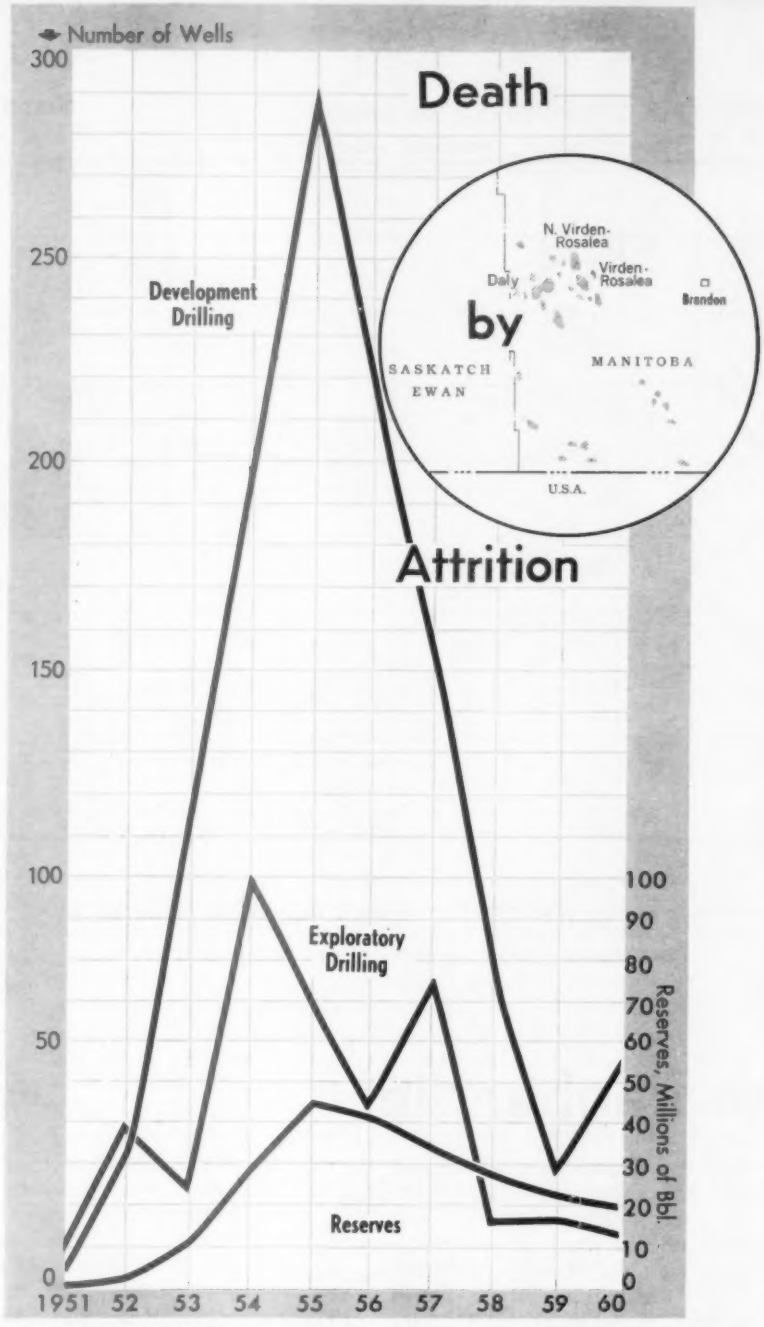


THE CHARTED HISTORY of Manitoba's oil history is a short and dramatic one. In only 10 years, it has gone full circle from a newly discovered province to a nearly abandoned one. Drilling is at an all-time low, production is declining, and reserves are dwindling away.

Manitoba oil crop may be withering on the vine

BY FRANK J. GARDNER

UNLESS something happens to revive industry interest, and soon, Manitoba promises to set an all-time record for the rise and fall of an oil province. The dramatic sequence is pictured in the curves above.

A case of paralysis. After an enthusiastic beginning in 1951, this western Canada region, first Williston basin discovery, rose rapidly in drilling, exploration, and production activity until 1955. Then, for lack of discovery, development paralysis set in with a vengeance. Today, Manitoba dips heavily into her proved reserves to sustain production, which is also on the skids. At the current rate of yield, (4.8 million barrels in 1960), those reserves (now estimated at 20.75 million barrels) are not long for this world. Cumulative production for the province stood at 34,583,020 bbl. as of the first of this year.

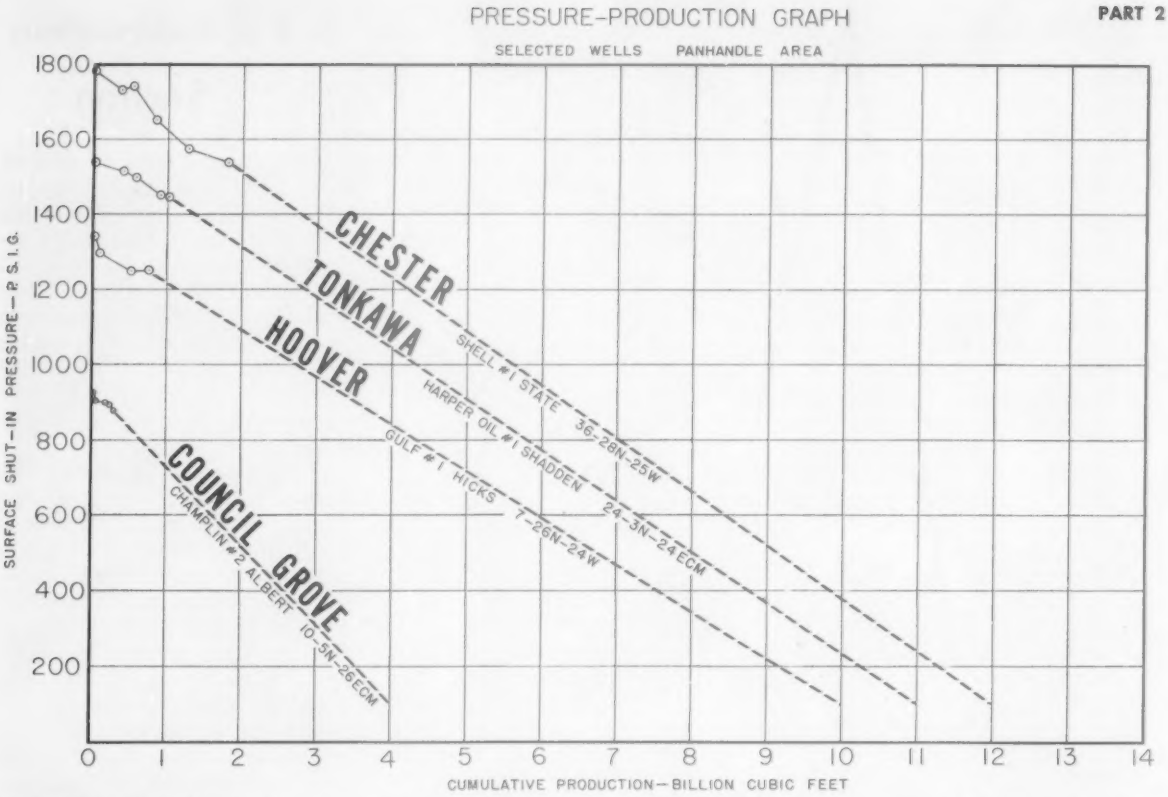
As drilling declined, reserves stopped growing, and production peaked at 6.1 million barrels in 1957. Today, wildcat drilling is at an all-time low; only 13 exploratory wells went down in 1960, with 3 of them finding small amounts of oil.

Has little hope for recovery. And there's little chance for a revival in Manitoba. The big finds that were anticipated following the discovery of Virden-Roselea, North Virden-Roselea, and Daly, failed to materialize. As failure followed failure, Canadian operators gravitated westward to Saskatchewan and Alberta, where the chances of success were better, though deeper. As a result, the three largest fields now yield more than 80% of the total production, and account for 80% of the productive wells in the province. They also produced nearly 90% of the cumulative.

Unlike the other prairie provinces, Manitoba offers no big natural-gas bonus to encourage exploration. Only minor amounts of gas have been found. But the fields do offer two advantages—they are nearer to market than other Canadian sources, and they are under no proration.

The "development drilling" curve on the chart displays a curious upturn in 1960. This was the result of small extensions to the Virden fields, and some drilling in search of deeper production, which proved fruitless.

The rise and fall of this once-promising region is a lesson in economics for government and industry alike—oil feeds on oil, and there's only one major element in its diet—incentive.



PRESSURE-PRODUCTION CURVES on four Panhandle producing zones indicate reserves to be expected. These are based on better producers and are not necessarily "typical" curves. Fig. 1.

Reserves may spell

Success for the Panhandle

BY B. E. BARBY
Consulting Geologist
Oklahoma City

THERE ARE 306 shut-in wells in the Panhandle. This is due to a variety of reasons, i.e., delay in FPC rulings, joint operation of producing leases, burdensome paper work, etc.

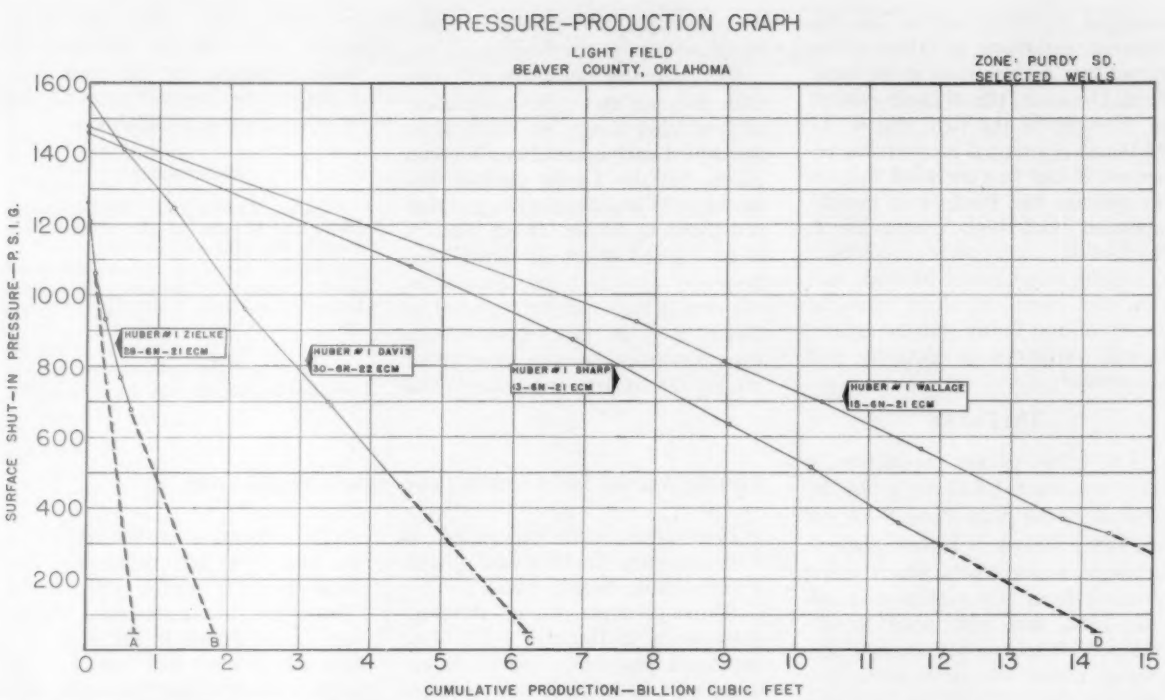
However, all of these factors do not excuse the excessive number of shut-in wells. Failure to recognize the danger of drainage is a very serious problem. Natural gas is a highly volatile substance which moves rapidly through a porous medium, and compared to oil, one producing gas well can drain large areas much more rapidly. Undeveloped tracts inside producing fields and shut-in wells inside fields are now being damaged by drainage. A prudent operator must evaluate the possibility of drainage on a zone-by-zone basis.

Another serious danger throughout the Panhandle in unallocated areas is the inequitable withdrawals from adjacent wells producing from the same zone. This problem was created by the many gas-purchasing companies, each having a different market demand and different rates of take. Some operators have attempted to balance the gas sales by "Deferred Take Agreements" between royalty owners and joint operators. However, these agreements have proved unsatisfactory to date. One solution is to expand the presently allocated areas and include the complete pool in every case, but allow operators to make up or balance current cumulatives before starting the allocation.

Reserves

Panhandle gas reserves are too vast a subject for a single discussion to cover the 2,600 wells involved. It is both dangerous and incorrect to generalize when speaking of reserves, since too many variations exist to apply an acre-foot recovery factor to each zone wherever it is found. However, accurate reserve predictions are critical for this area. Management is required to make daily decisions on well completions and new locations that could mean the difference between profit and loss.

Volumetric reserve calculations can be very misleading and are generally inaccurate due to the unknown lateral variations in productive thickness, permeabilities, and porosities. This is especially true in areas of wide spacing, and in areas where lenticular sandstone



MORROW PRODUCERS in Light field, Beaver County, demonstrate the extreme variations in reserves from wells in the same field. The over-all average of 12 wells in the field is 4,747 M.M.c.f. Fig. 2.

conditions exist. Results of pore-volume estimates are generally poor in this area except on such blanket sandstones as the Hoover and Tonkawa.

Once the wells begin producing, accurate reserve predictions can be made using the pressure - decline method. It is based on the premise that during the period when gas is being produced from a reservoir, the expansion of the gas which remains in the reservoir is closely a function of the pressure. However, allowances must be made when using this method for such factors as water drive, low permeability, and initial fracture treatment. For these reasons, using pressure declines too early can also be misleading. Many wells have exhibited a pressure loss in this area from the time of completion to the date of first production in the range of 100 to 200 psi. This could be attributed to poor cementing, improper completion, lost-circulation material in the formation. or fluid buildup in the hole.

Although it is still too early to evaluate all zones and all fields in the Panhandle area by pressure-production graphs, some wells have had sufficient production and pressure tests to make reserve predictions.

Shown in Fig. 1 are pressure-production curves on four separate producing zones, Council Grove, Hoover, Tonkawa, and Chester. It should be stressed that these reserves should not be considered typical for each zone. It was necessary to select those wells showing the most production and pressure points for more accurate reserve predictions. Therefore these curves are on some of the better wells, since the best wells have generally produced the most to date.

Curves on the Des Moines-Atoka and Morrow series are not shown on this figure. Sufficient data are not available on the Des Moines-Atoka production to develop decline curves at this time. Pressure - production graphs on the Morrow are shown in Fig. 2. In Fig. 1, an abandonment pressure of 100 psi. was used. Reserve predictions should be considered approximate, and all of these curves illustrate how few points are available.

All the pressure - production graphs were extended to show ultimate predicted gas recoveries at the time of reservoir depletion. These projected extensions were based on the attitude of the previous curve of each well and are shown by a dashed line.

Also note a corresponding rise in initial shut-in pressure with increased depth of the producing zone. The depth of the completed interval ranges from 3,268 ft. on the Hoover to 6,476 ft. on the Chester.

Large recoveries. Starting with the shallowest zone, the Council Grove curve is on the Champlin 2 Albert, Section 10-5n-26e. This well appears to have about 4 billion feet of original recoverable reserves.

The Hoover curve is on the Gulf 1 Hicks, Section 7-26n-24w. It apparently had 10 billion cubic feet of original reserves. The Tonkawa curve is on the Harper Oil 1 Shadden, Section 24-3n-24e and has approximately 11 billion cubic feet of reserves. The Chester curve is on the Shell 1 State, Section 36-28n-25w. It can be projected to show original reserves of 12 billion cubic feet. These wells all have amazing recoveries, but it is still too early to predict what effect surrounding wells will have on these when they begin producing at the same rate.

Shown on Fig. 2 are pressure-production curves on four wells producing from the Morrow series. These all produce from the same Morrow sandstone, the Purdy, at an average depth of 6,000 ft. Il-

lustrated by these curves are the extreme variations of Morrow reserves that are common in the same field. However, the over-all average of 12 wells in the field was 4,747 M.M.c.f. of original recoverable reserves. It can be concluded that on an average the Purdy is a prolific reservoir with high recoveries. It is doubtful that other sandstones occurring lower in the Morrow section will equal the high recovery factor of the Purdy due to greater lateral variations in porosity and thickness.[3]

The Future

The future of gas production in northwestern Oklahoma will be limited by the price allowed for gas by FPC. Unless a higher price is allowed, many tracts which could produce from 500 million to 1 billion cubic feet will never be developed. There is not enough economic return on such wells. Remember that gas sells for only one-fourth the price of oil by B.t.u. comparison. Thus, it is still in an unfair competitive position with oil.

The development of deep gas production in Texas County will be retarded, due to the vast producing area of the Guymon-Hugoton field. This field produces from the shallow 3,000-ft. section of the Wolfcamp. With all the acreage tightly held by production and a low gas price, there is not enough inducement for operators to develop the deep zones.

There is a great need for a new or better tool that will positively identify zones that will produce commercially. Electric logs, drill-stem tests, and cores do not offer enough information for completion decisions. This is an engineering challenge that could greatly affect the future of the area.

Ideally, a pore-volume reserve estimate should be made for each new discovery and the results compared to a representative pressure-decline for the same zone with similar characteristics on the nearest available well. As soon as enough pressure-production points are available, all reserve calculations should be based on the pressure-decline method. Conservative reserve estimates slow exploration work in any area. While accurate reserves are difficult to predict at the time of discovery, engineers have a tendency to be pessimistic and geologists optimistic about the results.

Success in the Panhandle will continue to hinge on correct correlation of producing zones. As more wells are drilled such correlations become easier, but the 1-mile distance between wells is a correlation gap that is difficult to bridge. There is much to be learned about all formations; however, what is being learned on the shelf trends can be expected to extend into the deep basin where the economics become even more critical due to increased depth and completion cost. Thus, the Panhandle area can be considered a proving ground for future deep drilling in the Texas Panhandle and all of northwestern Oklahoma.

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Pennsylvania field adds four new completions

Four wells were completed in Punxsutawney-Driftwood field, Pennsylvania, during April.

Three of these were development wells in Helvetia pool. Two produced gas while the third encountered salt water in the producing horizon (Onondaga chert-Oriskany sandstone interval) and was abandoned. The Joseph Jusnukis well by Devonian Oil & Gas Co. was the better of the two producers. This well produced 7,100 M.c.f.d. at a rock pressure of 2,680 psi. in 12 hours.

The fourth completion in this area was the Helen Rhines well by New York State Natural Gas Co. This wildcat was located about 3 miles southwest of one-well Sykesville pool. The Oriskany was found at 7,260 ft. with a show of gas and salt water which filled up 2,500 ft. of hole. The well was abandoned.

The rest of the completions during the month were all wildcats. Two of these wildcats were successful. The Fred Brooky well drilled by Sterling McClasky found 4,500 M.c.f.d. at a rock pressure of 1,080 psi. This Crawford County well was drilled 4 miles southwest of Indian Spring pool and produced from the Medina section. In this same area there are three wells currently drilling. The Jariki is an outpost of Indian Spring pool and the Gosick and Manko are wildcats drilling to the north and east of this pool. As yet there are no new locations between the Brooky well and Indian Spring pool.

The other successful wildcat was the Paul Benedum well at 5,206 ft. in the Tidioute area, Warren County, which was completed as a Medina discovery gaging 450 M.c.f.d. This is the first commercial Medina well to be drilled in the area. Several others have had shows of gas in the Medina, but the wells were abandoned due mostly to mechanical troubles. The nearest Medina production is 25 miles to the northwest. The Benedum discovery is about 60 miles due east of Indian Spring pool. The Red Medina in this discovery well was found at a depth of 5,837 ft. and gas was found at 5,925 ft.

Three wildcats along the Laurel Hill anticline were dry. The Piney Run Mining Co. well by Grabiak in Cambria County was drilled in a highly faulted area. After failing to find the first marker bed (Tully limestone) at 8,455 ft., the well was abandoned. A second wildcat on the same anticline was drilled in Clinton County some 100 miles northeast of the Cambria County well. This was Felmont's well on State Lands Tract 91. The Oriskany was found at 8,081-8,110 ft. and was dry. The third wildcat on this anticline was located about 35 miles farther to the northeast in Lycoming County. This was another Felmont wildcat on the W. P. Day farm. The well was fractured after finding the Oriskany at 7,835-88 ft. The results were a show of gas and some salt water; the well was abandoned.

The 1 Harvey Lieb, after drilling over 7,000 ft. of Triassic sediments and being bottomed in the Harper-Phyllite, was perforated at 6,520 ft. and obtained a holeful of salt water. The well was then abandoned.

May multiple completions

	Dual oil	Dual gas	Dual oil/gas	Dual gas/cond.	Triple oil	Triple gas	Triple oil/gas	Triple gas/cond.	Quad. oil	Quad. gas	Quad. oil/gas	Sex. oil
California		1	..	..	..	..	..	..	..	..	..	..
Colorado		4	..	..	..	..	..	..	..	..	..	..
Kansas	3	3	1	..	..	..	1	..	..	..	..	..
Louisiana	32	13	3	..	6	5	..	..	..	..	..	..
North	2	..	..	..	..	1	..	..	..	..	..	..
South	19	8	3	..	1	3	..	..	..	..	..	..
Offshore	11	5	..	..	5	1	..	..	..	..	..	..
Mississippi	1	..	..	..	..	..	..	..	..	..	..	..
Montana	1	..	..	..	..	..	..	..	..	..	..	..
Nebraska	4	..	..	..	..	..	..	..	..	..	..	..
New Mexico	3	3	1	..	..	..	1	..	..	..	..	..
Oklahoma	24	6	..	1	3	3	1	..	..	..	..	..
Texas	30	30	8	9	8	4	1	1	2	3	1	1
Dist. 1	..	1	..	..	1	..	..	..	..	..	..	..
Dist. 2	3	9	..	..	..	..	1	..	..	..	..	..
Dist. 3	8	5	..	9	..	..	..	1	..	..	..	..
Dist. 4	7	9	3	..	1	4	..	..	2	3	..	1
East	3	..	1	..	2	..	..	..	..	..	..	..
Dist. 7-B	2	..	..	..	..	..	..	..	..	..	..	..
West	4	..	1	..	4	..	..	..	..	..	..	..
Dist. 9	1	1	1	..	..	..	..	..	..	..	1	..
Dist. 10	2	5	2	..	..	..	..	..	..	..	..	..
Wyoming	3	..	..	..	..	..	..	..	..	..	..	..
Total May	101	60	13	10	17	12	4	1	2	3	1	1
Total multiple	225	..	..	..	..	..	..	..	..	..	..	..

Duncan Slough field in South Texas is confirmed

An oil confirmation discovery to Duncan Slough field, Matagorda County, Texas Gulf Coast, is completed. The Humble Oil & Refining Co. F-4 Frio sand discovery, 4 J. C. Lewis, flowed 268 bbl. of oil daily and 873 M.c.f.d. from perforations at 10,637-643 ft. Location is 3 miles south of Buckeye in the Christopher G. Cox Survey, A-18.

LaSalle County. C. L. Buzz Morgan 2-112 South Texas Syndicate, Section 112, H&GN Survey, 12 miles southeast of Los Angeles, LaSalle County, Texas, flowed 30 M.M.c.f.d. plus condensate at the rate of 94,000:1, from perforations at 5,071-75 and 4,616-26 ft. Flow from the lower section was 11,600 M.c.f.d. Location is off the west flank of Washburn Ranch field.

Calhoun. Mayfair Minerals Inc. completed 1 Marjorie Holland Smith in Calhoun County flowing 12 M.M.c.f.d. from perforations in Frio at 9,433-55 and 9,459-64 ft. Location of this new gas area is 9 miles west of Port Lavaca in Manuela Venitez Survey, A-39.

A road for Shell

Contractors are building a road for Shell Oil Co. across several miles of remote Pecos River country in Terrell County, Texas, to location for 331-1 Mitchell in the Brown-Bassett field area. The lower arrow points to road construction spot on a canyon side. The upper arrow points to the Pecos River. The 331-1 Mitchell well is a proposed 14,200-ft. Ellenburger test which Shell hopes will extend prolific Brown-Bassett, one of the gas majors of Texas. Photo courtesy The Wrangler.

Deep extension try slated for Gulf Coast discovery

A 14,000-ft. Frio test will attempt an extension and confirmation of a recent major gas-condensate discovery in Trull field, Matagorda County, Texas Gulf Coast. Tenneco Corp. 1 M. L. Davis Gas, unit II, 4,990 ft. south of the nearest well in the field, Tenneco 1 M. L. Davis Gas unit I, will try to confirm the big strike that flowed 23,300 M.c.f.d. and more than 6,141 bbl. of condensate daily from perforations at 12,090-12,120 ft. from 250 ft. of net pay including seven separate gas-condensate reservoirs. Location is 7 miles southwest of Blessing in the John Smith Survey, A-385.

Exploration Outlook

Utah holds interest in Rockies

UTAH continues to be one of the most interesting and successful exploratory theaters in the Rocky Mountains. With the last half of the year near, operators have drilled more than 100 wells, about half of them wildcats in 1961. Operators are busy at 55 active locations throughout the state, about evenly divided between the Paradox and Uinta basins.

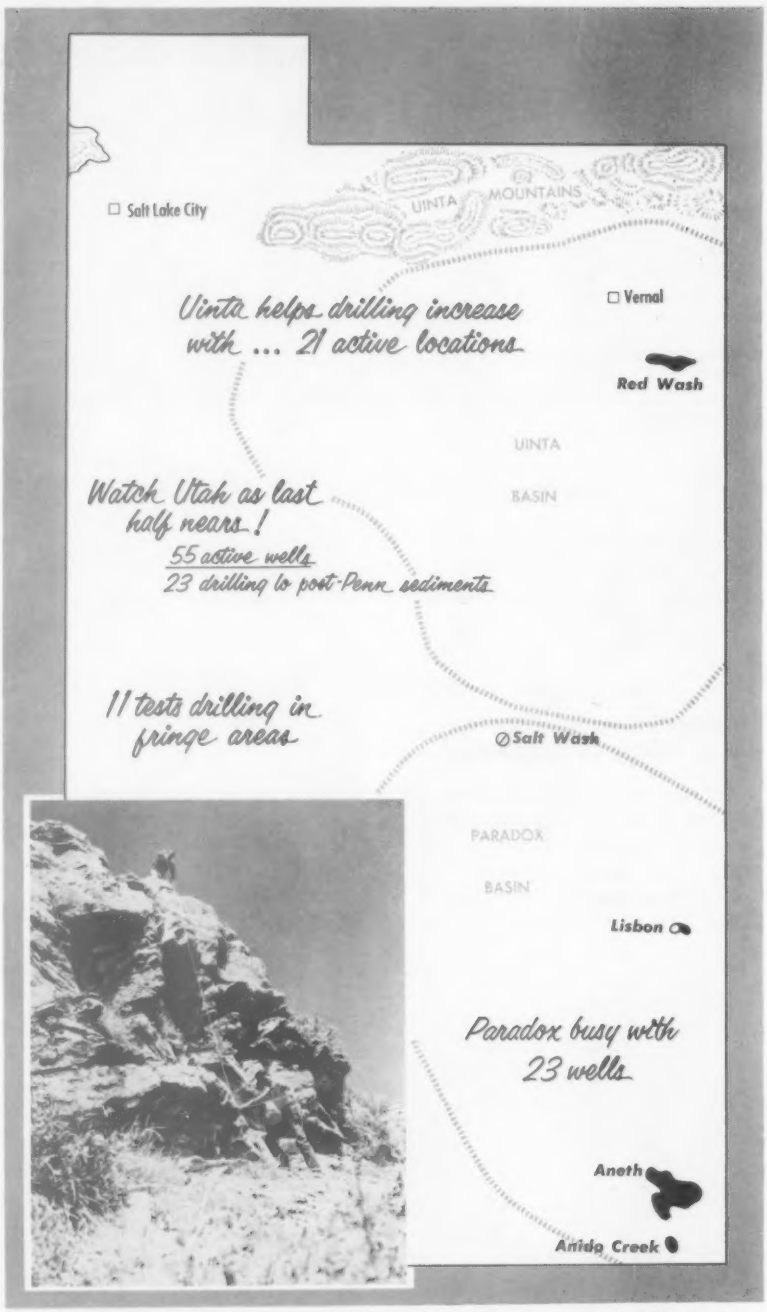
Exploratory drilling has uncovered five new fields this year. Total wildcatting is running about neck and neck with 1960 exploration, stimulated by a new wave of enthusiasm in the Uinta basin's post-Pennsylvanian prospects.

Despite the Paradox play

. . . Uinta operators have increased their exploration this year. While most of the state's work has been in the Pennsylvanian and older rocks in the southeastern Paradox basin, Uinta drillers are taking a serious look at younger formations. There are 23 wildcats in Utah slated to objectives younger than Pennsylvanian. Most of these are located in the Uinta basin—11 in Uintah County, 1 in Wasatch County, and 11 in Grand County. Five wildcats are going to Pennsylvanian, four of them in San Juan, one in Emery County. Two Mississippian wildcats are on the books, one each for Emery and San Juan counties. Five tests will go to Cambrian, three in Emery, and one each in San Juan and Washington counties.

Emphasis is on gas

. . . in northeastern Utah's Uinta country. This surge in activity and interest is partly due to proposals for more gas outlets from fields already discovered and from the expected new discoveries coming. So far, proposals for more direct outlets from Uinta fields are for intrastate markets.



WILDCATTERS IN UTAH are enjoying an exploratory comeback as drills begin to busy themselves in the Paradox and Uinta basins as well as fringe and upland areas.

First commercial gas production in Utah was a Cisco Dome, opened in 1925. Production is from Dakota Cretaceous rocks. The field lay idle for many years until 1956 when drilling resumed. Until 1950 there were only four commercial oil and gas fields in the state. Today the producing areas number more than 40. Production comes from rocks ranging in age from Tertiary down to and including Devonian. Practically every type of oil and gas reservoir is represented.

There are two general gas-producing areas in the Uinta basin—the Uintah gas area and the Book Cliffs - Douglas Creek arch area. When the 94-mile Mountain Fuel Supply Co. gas pipeline is completed, gas from Utah's fields will flow across Uinta basin to connect

with the Utah Natural Gas Co. line near Clear Creek field. This line will undoubtedly bring the exploratory push that Utah operators have so long awaited.

Most interest of late has centered in the Paradox basin where Aneth, Anido Creek, and other prolific Pennsylvanian fields captured the industry's favor. Uinta's next move will be toward proving extensions and new pays around present fields. The Uintah and Book Cliffs-Douglas Creek arch gas areas will push towards each other.

Although there will be much drilling into the post-Pennsylvanian sediments, the Permian, Mississippian, and Devonian sections should not and will not be overlooked. There will be a much-needed entry into the western part of Uinta basin where the formations and stratigraphic conditions equal those on the eastern and productive side. Due to thicker sediments and more complex structure and stratigraphy, many potential discoveries await only the wildcatter.

Utah will soon get out of the Aneth and Lisbon rut.

—John C. McCaslin

Open flow gas reported in eastern Kentucky well

In Big Sandy gas field, Pike County, Kentucky, United Fuel Gas Co. recently completed 8814 G. C. Bevins for an open-flow gas potential of 8,560 M.c.f.d. Located on Rockhouse Fork the test produced from Devonian brown shale at a total depth of 3,600 ft.

Dual completion planned at Mississippi discovery

A big Rodessa and Sligo discovery is flowing 1,080 bbl. per day in Jones County, Mississippi. The discovery is E. L. Erickson 1 W. E. Weems et al., 22-9n-10w.

Flow was 504 bbl. of oil per day from perforations at 10,704-16 ft. in Rodessa. Sligo perforations at 11,221-24 and 11,227-35 ft. flowed 576 bbl. per day through ¼-in. choke. Other good oil shows were reported in the hole. Placid Oil Co. is moving in for the south offset and confirmation at 1 George Smith in C SE NE 22-9n-10w. It will go to 12,000 ft.

Canada's windfall gains new gas pay

PIN ANOTHER tack on that wall map for the Windfall district of Central West Alberta, for this increasingly important gas area has added another potential gas-producing formation to its already favorable record.

This area, lying about 120 miles northwest of Edmonton, had a gas discovery in the D1 zone of Devonian and along with a gas flow rate of 3 M.M.c.f.d. the discovery drill-stem test showed some light-gravity-oil indications. The strike was made by the same team that has so successfully developed significant D3 zone of Devonian gas reserves in this region—Canadian Fina Oil, Ltd., Pan American Petroleum Corp., and Hudson's Bay Oil & Gas Co., Ltd.

The new discovery well was Fina-Pan Am.-H.B. 9-35-60-16 Windfall, situated on LSD 9, 35-60-16w5. It lies 1½ miles northwest of the D3 zone of Devonian Windfall field gas completion and it is just 1 mile northwest of a D3 oil completion, one of three such wells in the immediate district.

Drill-stem test of a 100-ft. interval between 7,010 and 7,110 ft., with valve open 2 hours, shut in 30 minutes and 45 minutes respectively, gassed at maximum rate of 3 M.M.c.f.d. By end of test flow has subsided to 1,500 M.c.f.d. and when pipe was pulled it showed 120 ft. of clean light-gravity crude, 480 ft. of gas and oil-cut mud as well as 270 ft. of salt water.

Productivity of the new discovery horizon will not be known for a while yet, for the well is now being deepened to its main objective—the D3 zone of Devonian. It is quite likely that production tests of the horizon will be attempted following completion depth but this again will depend on lower zone prospects. At last report contractor drilling the hole, General Petroleums Drilling, Ltd., was making hole below 8,182 ft., with projected depth set at the 8,500-ft. level.

Interest in this indicated gas discovery and a large part of the acreage in the immediate vicinity is split 42⅔% each to Pan American and Hudson's Bay, with the remaining 16⅔% going to well operator Canadian Fina, Ltd. The team holds extensive interests in this area having acquired a huge spread of 11 adjoining reservations early in its exploration project.

The group's drilling efforts have been well rewarded. Eight D3 Devonian gas completions have been recorded and Windfall field as presently defined by the Alberta Oil and Gas Conservation Board encompasses an area of 38 sections. The field is 6 miles wide at its widest part and has a distance of 9 miles between north and south gas completions. Along the west flank of the gas area the D3 zone has been proved productive of light-gravity crude and immediately south of the field limits is a Mississippian oil completion.

Windfall is being developed by its backers as one of the key sources of gas supply for the Alberta-California gas-export project. The development team has been testing gas pilot-plant cycling facilities for several months. This installation cost $3,500,000 and was designed to give production data on liquid recovery from the D3 zone of Devonian gas. A liquid-petroleum-gas pipeline was constructed from the plant site in Township 60, Range 15w5, to the Edson terminal of the Trans Mountain Oil Pipe Line. Liquid recovered from the plant is batched at the Edson pipeline terminal and shipped in sizable quantities for Shell Oil's account to Anacortes, Wash. The 1,600-odd bbl. that the plant now produces will jump to 14,600 bbl. daily when gas from the field is produced for processing and ultimate delivery to Alberta and Southern Gas Co. Plant expansion now under way will be completed late this year. Facilities will cost about $26,000,000. At that time as well as supplying upwards of 132 M.M.c.f.d. of residue gas to the export project, Windfall will yield the 14,600 bbl. of LPG and about 650 tons of sulfur daily. Presently gas is being reinjected into the formation and no sulfur recovery is being made.

Thus shortly Windfall, not too long ago just a road marker on the Alaska Highway between Edmonton and Fort St. John, will make an even bigger name for itself in the oil and gas industry of western Canada.

Arkoma stays active

ACTIVITY continues brisk in southeastern Oklahoma's Arkoma basin.

Frankfort Oil Co. has a new-pay discovery prospect in Norris Deep field, Latimer County, at 1 Hulsey, NW NW SE 18-6n-22e. Gas flowed from Fanshaw at 6,296-6,320 ft. on test. The Fanshaw is above the Red Oak in the Atoka Pennsylvanian. Gas from Red Oak perforations at 6,803-6,926 ft. flowed at the daily rate of 3,330 M.c.f. through ¼-in. choke with tubing pressure at 2,168 psi.

Flow from the Fanshaw was up to 240 M.c.f.d. on ¼-in. choke after acid treatment.

Midwest Oil Corp. 1 Coblentz in SE SW NE 16-6n-22e, was mudding up to continue fishing at 8,492 ft. That well made 839 M.c.f.d. In LeFlore County, on the east end of the Brazil anticline, Midwest 1 Goldsborough, SE SW NE 31-7n-23e, was running surveys at 13,381 ft. Porosity was found in lime. The wildcat made 738 M.c.f.d.

Wilburton. Cromwell sand is a new pay for Wilburton field in Latimer County. The discovery well is Ambassador Oil Corp. 1 McAlester, C SW NE 22-5n-18e. Perforations at 9,210-27 and 9,241-42 ft. flowed 1,635 M.c.f.d. through 1-in. choke, natural. Following acid wash, the well flowed 8,068 M.c.f.d. on 1-in. opening. Operator will complete the well dually in the Spiro basal Atoka sand, the regular field pay. A drill-stem test in the Spiro at 8,288-8,396 ft. got 6,700 M.c.f.d.

A NEW PAY for Norris deep field, Latimer County, a promised discovery on the east end of the Brazil anticline, and a new pay for Wilburton field made up the Arkoma basin development news.

Alberta's Wimborne field adds new well

An important Devonian discovery is reported on the west side of Wimborne field in Alberta. The well is British American Oil Co., Ltd., and Banff Oils, Ltd., 10-27 Litz Wim, LSD 10, 27-33-26w4.

Devonian D3 reef, a new pay for this region of Alberta's southern portion, flowed 31.5 bbl. of oil in 165 minutes during test at 7,434-54 ft. The D2 Nisku made 58 bbl. in 140 minutes through 26/64-in. choke from 60-ft. interval at 7,340-7,400 ft.

Northwest Territories. Imperial Oil, Ltd., officially released details on its F-7 Netla discovery in the Arrowhead River area of Northwest Territories. The Middle Devonian discovery flowed 24 M.M.c.f.d. from 44 ft. of net pay on April 5. Pay is at 6,399-6,437 ft. Location is at N. Lat. 60° 46′ 15.04″, W. Long. 122° 46′ 15.02″.

New gas pool discovered in California

In Sutter County, California, Buttes Gas & Oil Co. is drilling ahead below 5,000 ft. after having a gas show in a wildcat that should be a new pool discovery in the Marysville area of the Sacramento Valley.

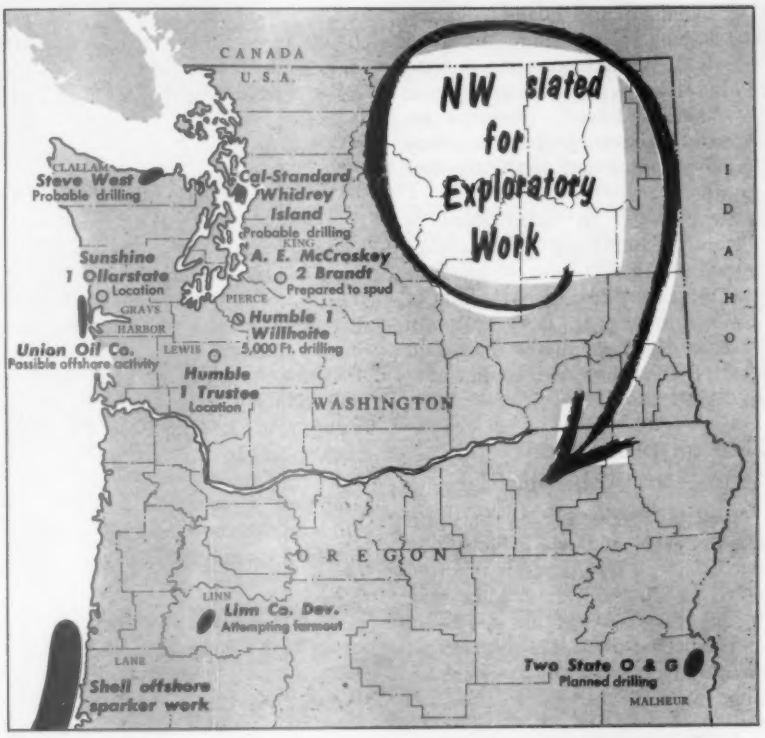
The 12 Buttes-Carroll in 32-16n-1e flowed at the rate of 1,090 M.c.f.d. through a ⅜-in. choke during an open-hole test at 4,818-40 ft. in the Forbes zone. Buttes is drilling toward a target of 6,500 ft.

The 17 Buttes - Carroll is 1½ miles northwest of the company's 16 Buttes Community, which was completed as a new pool discovery in March. West Buttes field is 2¼ miles northwest of the well.

New gas well for Arkoma

A big gas well is reported on the Arkansas side of Arkoma basin. Discovery is on the northeast edge of Gragg field in Sebastian County. The well is Gulf Oil Corp. 1 A. M. Duckett, NW SE 20-6n-29w.

This well flowed 43,700 M.c.f.d. from open hole at 4,207 ft. Well is producing from perforations in 30 ft. of net pay at 4,177-4,226 ft. Pay is the Atoka Pennsylvanian sand. Nearest production in the field is 1⅜ miles southwest.



THIS MAY WELL be the big exploratory year in the Pacific Northwest. Drilling is planned in several areas as well as an increase in surface and marine exploratory work.

Washington, Oregon having active exploration year

BY R. J. DEACON
Northwest Oil Report,
Portland, Ore.

OIL and gas exploration in Oregon and Washington is shaping up to indicate that 1961 will be one of the more active years in Pacific Northwest wildcat activity. Several developments in both states are under way or planned soon.

Oregon

Principal exploratory attention is focused on possible offshore activity. Legislation which would allow offshore exploration recently passed the Senate by a strong majority. The tideland leasing bill has also passed the House of Representatives and awaits only the governor's signature to become law.

The tideland bill contains provisions for a 10-year lease with a 5-year drilling commitment and a minimum 12½% royalty. The acreage parcel which will be put up for competitive bidding will be approximately 13,000 acres (6 statute miles along the shore and 3 geographical miles seaward) and will carry a minimum annual rental of 50 cents per acre.

Shell Oil Co., who originally created interest in Oregon's coastal area by filing on the entire coast, is currently doing sparker work off Coos Bay and surface geology in the upland areas. At least two additional major companies also are doing surface work and probably could be considered as potential bidders for offshore parcels along with Shell.

In addition to exploration interest in the coastal area, it appears likely that drilling will be done in the Willamette Valley of western Oregon and possibly the Vale area of the Snake River downwarp in eastern Oregon. There are no active wells in Oregon.

Humble Oil & Refining Co. is providing the main exploration effort in Washington at this time. Humble is currently drilling at 4,500 ft. on its projected 5,000 ft. 1 Willhoite approximately 20 miles southeast of Olympia. The company recently drilled two dusters in Lewis County, which included the 1 Brown, et al., TD 4,484 ft., 15-11n-1e and 1 Rosa Meyer, TD 4,482 ft., 8-12n-2e. A third Lewis County location has been staked for 1 Everette Trust & Savings Bank Trustee. This well will probably be next in line after the currently drilling 1 Willhoite and could be a deep test.

A. E. McCroskey Syndicate is preparing location for 2 Brandt in 34-21n-6e, King County. The well is scheduled for 3,400 ft. as a test for Eocene Puget sands and will be located on the northeast flank of the Kummer anticline, approximately 300 ft. north of the operator's recent dry hole, 1 Brandt. For additional information on this activity refer to The Oil and Gas Journal, February 1961, "Washington Driller Aims to Hit Oil Pay."

In the Ocean City area of western Grays Harbor County where Washington's only oil production has been obtained, Sunshine Mining Co. recently abandoned its 1 Beach at a total depth of 3,115 ft. This was the fourth test in the past 8 months for the joint operators, Sunshine Mining Co., Cascade Natural Gas Co., and Natural Gas Transmission Co., to establish commercial production in the one-well Ocean City field. While gas and oil shows were reported from three of the wells, no commercial potential has as yet been reported. Sunshine Mining Co. apparently will continue to explore the area for the right combination of drilling methods, engineering, and the possibility that a new zone will be found that will eliminate difficult drilling and completion problems.

Union Oil Co.'s recent acquisition of significant offshore acreage opposite to the Ocean City area has two important implications. Perhaps the most important is that Union may be reentering Pacific Northwest activity after an absence of approximately 10 years. It will be remembered that Union was the first to obtain excellent shows of oil

and gas in the Ocean City area during the latter 1940's and early 1950's. Secondly, it is encouraging that a major company with adequate financing and technical personnel may be entering the Ocean City area where difficult technical problems of drilling and well completions have plagued past operations.

The inability of a major operator to acquire large blocks of land at reasonable wildcat prices has been one of the major problems in Ocean City exploration.

Two areas in the Puget Sound area, Clallam and Island counties, are shaping up for drilling this year. Standard-Western completed offshore seismic work in areas adjacent to Whidbey Island. Standard reportedly plans to drill on Whidbey Island sometime during the summer months.

Steve West, an independent, is currently assembling final acreage within a ±6,500 acre block near Port Angeles; West plans drilling of this well in August. Both wells will be considered as highly significant tests of Oligocene and Eocene marine sections.

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First oil production tapped at Abbeville, La.

First oil production on the north flank of Abbeville field in Vermilion Parish, South Louisiana, is reported at Riverside Oil Co. 2 Lula Mae Meaux Broussard et al., 8-12s-3e.

The well flowed 126 bbl. of oil per day from upper Motty perforations at 5,560-61 ft. Flow was through ⅛-in. choke.

Pierre Pass. The fourth producer for this Assumption Parish field is Union Texas Natural Gas Corp. 1 William, on the west side of the field. It made 152 bbl. of oil per day from perforations at 13,250-54 ft. Location is in 24-13s-12e.

New Reagan Cambrian pool opened in Northwest Kansas

Decatur County has a new Reagan sand discovery at Sauvage Drilling Co., Inc., 1 Lawson, C NE SW 11-1s-26w, 5½ miles east of Warner field in the northeastern part of the county.

The well, opener of Lawson field, is producing from perforations in Reagan at 3,562-65 ft. Pumping equipment is now being set up. Recovery during drill-stem test at 3,559-66 ft. was 420 ft. of free oil. Oil was also received from Lansing-Kansas City Pennsylvanian at 3,413-82 ft.

Ness County. Kern Drilling Co. completed 1 Burgess to open Southwest Arnold field 12 miles northwest of Ness City in southwestern Kansas. The well pumped 123 bbl. of oil per day from Mississippian perforationsat 4,464-72 ft. Location is 1¾ miles southwest of Arnold field.

Kiowa County. Falcon-Seaboard Drilling Co. 1 Brensing, C SE SE 16-27s-20w, 1½ miles west of Fralick field and 6½ miles northwest of Mullinville, flowed 4,250 M.c.f.d. and 35 bbl. of oil per day from Mississippian at 4,868-78 ft.

Two important wells completed in Louisiana

Two significant oil producers—a new field wildcat and a triple-producing development well—have been completed by Gulf Oil Corp. in Louisiana.

The successful wildcat is the 1 Mark Delesdernier, located 2 miles east of West Bay field. Perforated at the interval 8,670-81 ft., it flowed 346 bbl. of 37°-gravity oil per day through a 10/64-in. choke.

Gulf's 24, Block 21, offshore Timbalier Bay field, was completed as a triple producer with a potential of 930 bbl. per day. Four productive sands in a new fault block were logged for 140 net feet of pay. Perforations were at the intervals 10,623-36 ft., 10,495-10,525 ft., and 10,178-90 ft. Gravity ranged from 26.2°-27.3°.

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On a West Texas well, drilling with mud below 12,000 feet, four Reed Cobra bits drilled 2,289 feet in 404½ hours. On an offset well it took 37 tooth bits to drill 2,172 feet in 558 hours. On another West Texas well a Cobra bit set an air drilling record of 3,644 feet in 103 hours.

In Pennsylvania, drilling with air, it is routine for one Reed Cobra bit to complete the hole from surface casing to TD. In this area total footage per Cobra bit regularly exceeds 7,000 feet.

Drilling with mud in East Texas in the tough Travis Peak formation Cobra bits consistently get runs up to 250 feet. Drilling with gas in Mississippi 10 Cobra bits drilled 6,850 feet in 358½ hours. In the same vicinity more than 10 times this number of tooth bits were required to drill the same footage with mud.

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Retarded Acid Gets Results in Problem Wells

This table shows some of the recent results of Retarded Acid treatments performed by Dowell on problem wells in many areas. We hope it gives you some ideas that will result in greater profits from your wells.

LOCATION	NAME OF FORMATION	AMOUNT OF RETARDED ACID	RESULTS
Albert, Canada	Slave Point Mid Devonian Vugular lime	4000 gallons (acid-oil-emulsion type)	Production from old well went from 0 to 218 bopd.
Franklin County, East Texas	Limestone	30,000 gallons	16-fold gas production increase—from 400 mcfd to 6400 mcfd.
San Juan County, Utah	Paradox (Desert Creek Zone)	75,000 gallons (acid-oil-emulsion type)	Production boost from old well was 34 to 450 bopd in field where regular acid treatments are usually unsuccessful.
Ellis County, Kansas	Kansas City Lansing	2000 gallons (acid-oil-emulsion type)	Production nearly three times that of offset wells. $881 treatment cost paid out in 19 days.
Andrews County, West Texas	Pennsylvanian	10,000 gallons (acid-oil-emulsion type)	Production from old well boosted from 10 bopd to 60 bopd stabilized. This 50 bopd increase was made in a field where offset wells treated with 10,000 gallons regular acid usually yield an uneconomical 5 bopd increase.
Logan County, West Virginia	Big lime	4000 gallons	Production increased 100-fold to one million cfpd. Treatment cost paid out in two weeks. Entire well cost paid out in less than five months.
Lea County, New Mexico	Wolfcamp lime	3000 gallons (regular type) 15,000 gallons (acid-oil-emulsion type)	Well tested 275 bopd flowing. Other wells in field, given regular acid treatments, do not usually respond properly.
San Juan County, Utah	Paradox	40,000 gallons	Decline rate was reduced by treatment. Production was increased from 200 bopd to 700 bopd. Six months later production was still 700 bopd.
Alberta, Canada	D2	5000 gallons	Production from eight-year-old well had declined to zero with fluid level only 65 feet. One month after treatment, production had leveled off at 100 bopd, flowing.
Russell County, Kansas	Kansas City limestone	3000 gallons	Production boosted from 3 bopd to nearly 2000 bopd on test after clean-up.
McKenzie County, North Dakota	Madison lime	7000 gallons (acid-oil-emulsion type)	Production from old well increased from 35 bopd to 133 bopd after treatment. $3101.00 treatment paid out in 23 days.
Harrison County, East Texas	Pettit Oolitic lime	7000 gallons	Treatment of six-foot pay resulted in 40 mmcfd well with 60 barrels petroleum liquids per million.
Wabash County, Illinois	O'Hara lime (Highly soluble)	3000 gallons (acid-oil-emulsion type)	Well production stabilized at 75 bopd and treatment cost paid out in ten days. Regular acid had given poor results on nearby wells.
Fremont County, Wyoming	Embar lime	5000 gallons (acid-oil-emulsion type)	21 boph test from a pay that had been acidized and abandoned several years before. This treatment saved a well that would have been plugged otherwise.

Almost without exception, these treatments employed other Dowell products and services in addition to Retarded Acid. Most of the more recent treatments listed here were designed by Dowell engineers with the aid of the Acid Guide* – a method developed by Dowell for use in engineering acid treatments to get optimum results.

Take full advantage of Dowell's long experience, proved additives, and engineering ability. Call Dowell to perform your next acidizing treatment. Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Venezuela, Argentina, Germany, France and the Sahara area. Dowell, Tulsa 1, Oklahoma.

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THIS IS A PORTION of the updated Geo Map Co. Map 301, "Jurassic Drilling in Northeast Texas." An upswing in Jurassic exploration in recent weeks brought with it a need for better map coverage. Geo Map Co., Box 30332, Dallas, has reprinted this East Texas map in three colors.

Eight Jurassic discoveries recorded in East Texas, 1960

THE FIRST EDITION of Geo Map Co.'s Map 301, Jurassic Drilling in Northeast Texas, was printed in July 1960. Since that time, more than 50 new Jurassic wells have been staked. There are more than 20 active wells in this play now. Last year's exploration tapped several discoveries which have major economic importance, and current deep exploration has reached a high peak.

Geo Maps has brought Map 301 up to date, reprinting it in three colors. The map is contoured on top of the Smackover. Scale is 1 equals 5, over-all size is 35 by 45 in. Order from Geo Map Co., Box 30332, Dallas 30.

Triple completion is first for Texas' Frelsburg field

Frelsburg field in Colorado County, Texas, gained its first triple completion. The well is Carthay Land Co. 1 Carl Grimes & A. J. Thompason.

The well made 6 M.M.c.f.d. plus condensate from 15-D sand perforations at 9,290 - 9,309 ft.; 6,600 M.c.f.d. from 15 sand at 9,090-98 ft.; and 3,800 M.c.f.d. from 12 sand at 8,508-24 ft.

Quadruple completion reported in North Texas

Christie, Mitchell, & Mitchell 2 Paul Curtner, western Wise County, is the second quadruple producer for North Texas. The well flowed 113 bbl. of oil per day in the Atoka 5,900-ft. Conglomerate zone plus 243 M.M.c.f. of gas on ¼-in. choke; 122 bbl. per day from Atoka 5,500-ft. Conglomerate zone plus 193 M.M.c.f. on ¼-in. choke from 5,420-28 ft.; 96 bbl. daily in Strawn plus 121 M.M.c.f. on ¼-in. choke from 4,070-97 ft.; and 625 M.M. c.f.d. plus 2 bbl. condensate from Morris at 4,340-56 ft. through 10/64-in. choke. Location is in J. H. Martin Survey, A-576, Boonsville Bend conglomerate gas field.

Texas adds remote find

Remote Wilcox gas production is reported at a wildcat in Colorado County, Texas Gulf Coast. The discovery is Brazos Oil & Gas Co. 1 C. H. Matthews et al. in the James Nelson Survey, A-35. The well flowed 2 M.M.c.f.d. plus 18 bbl. of condensate per million from perforations in the upper Wilcox at 9,698-9,714, 9,658-88, and 9,620-30 ft. Nearest production is 3 miles southwest of Franka Kennelly field.

Cherokee discovery extends Texas Panhandle field

Cleveland Pennsylvanian production is reported at Amarillo Oil Co. 1 M. W. Broyles, 2½ miles northwest of Mammoth Creek field in northeastern Lipscomb County, Texas Panhandle. The well flowed 7 M.M.c.f.d. from perforations at 7,347-59 ft. TD is 9,730 ft.

Location of this extension discovery is 5 miles southwest of Follett town and 3 miles northwest of nearest gas production in Mammoth Creek field. Spot is Section 978, Block 43, H&TC Survey.

Wilcox discovery flows gas in Goliad County, Texas

A Goliad County wildcat in South Texas flowed 9,200 M.c.f.d. from Wilcox perforations at 9,926-37 ft. Discovery is Cosden Petroleum Corp. 1 S. E. Crews III, 5 miles northeast of Riverdale field.

This discovery is located in the Maria Jesua de Leon Grant, A-22, 5 miles northwest of Goliad, Tex.

Strawn discovery finaled in Hockley County, Texas

A flowing Strawn Pennsylvanian discovery is reported in northeastern Hockley County, 9 miles southwest of Anton in West Texas. The well is Jake L. Hamon and Champlin Oil & Refining Co. 1 Spade Farms Inc.

Discovery flowed 301 bbl. of 41°-gravity oil per day on test through 14/64-in. choke from perforations at 10,016-22 ft. Location is in Section 45, Block A, R. M. Thompson Survey.

Offset to new Ohio pool flows Clinton oil, gas

In Ohio's southwest Pleasant Township, Perry County, the first offset to a new pool discovery was reported as a 160-bbl. producer that also gaged 692 M.c.f.d. of gas after fracture.

Ridgedale Oil & Gas Co. 1 Susie Vargo, Sectiton 1, found the Clinton at 3,606-39 ft. with 20 bbl. natural.

• Roy Weed moved across the township line to complete 1 Ralph Akins, Section 20, Tiverton Township, Coshocton County, as an extension to West Spring Mountain pool. It gaged 2,740 M.c.f.d. after fracture with a rock pressure of 925 psi. The Clinton sand at 3,341-67 ft. had 100 M.c.f.d. natural.

Michigan drilling permits increase

Michigan drilling activity, off from last year, showed a good splurge with 40 drilling permits for the week setting a year high and topping 1960 for the same week. However, total starts still lag behind last year.

St. Clair, Calhoun, and Jackson counties accounted for most of the new starts.

Mask, Wood & Markel 1 Wilson, NW SW SW 11-3s-4w, Calhoun County, completed for 190 bbl. oil per day in Trenton at 4,351 ft. while an offset in Albion field set an interesting first for the Albion-Scipio trend. It was the fifth producing well on an east-west line, each 1,320 ft. apart, and marked the first time as many as five wells have produced east-west across the fracture, which runs 40 miles on a southeast trend.

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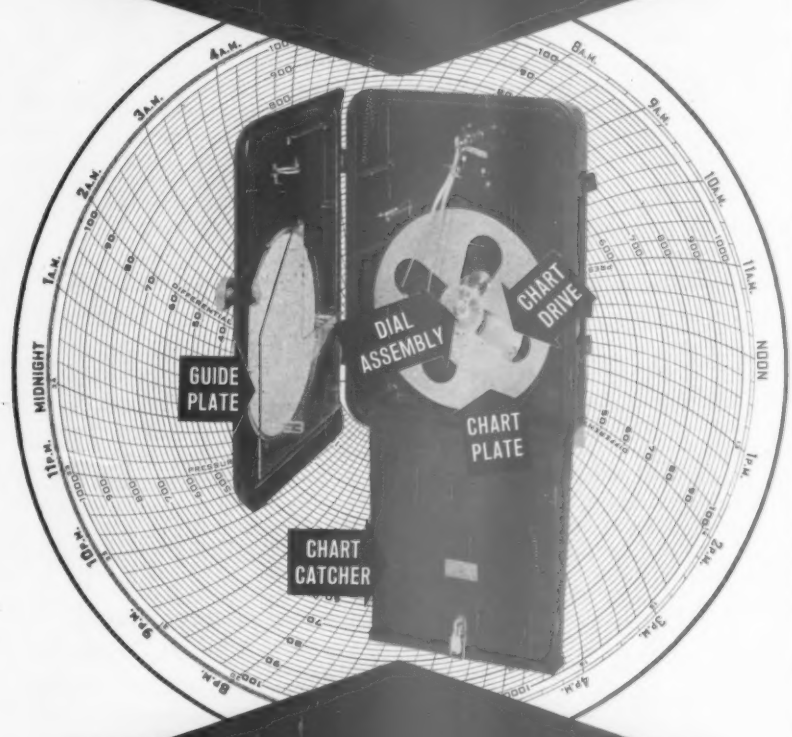

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Ohio's Union Furnace pool moves eastward in Hocking

In Ohio, A. M. Carlson reports an eastward extension of Union Furnace pool in Washington Township, Hocking County. The well made 320 bbl. of oil in a 12-hour test after fracture. The 3 W. A. Cooper, Section 28, logged the Clinton sand at 2,775-2,804 ft. and had 25 bbl. natural.

California's Vernalis gas field extended

In California, production in Vernalis gas field, San Joaquin County, has been extended 1½ miles southwest by a 5,225-ft. wildcat drilled by John M. Young, an independent.

The 1 Young unit was completed flowing at the rate of 1,250 M.c.f.d. from a 21-ft. section of the Upper Cretaceous sand at 4,234-65 ft. The flow was through a ¼-in. choke with a flowing pressure of 900 psi.

Nevada wildcat abandoned

Another wildcat venture in Nevada has failed.

Suntide Petroleum Co. has abandoned its Nevada Federal 1 in 5-15n-75e of White Pine County at 2,681 ft. No additional drilling plans have been announced, but Suntide's parent, Sunray Mid-Continent Petroleum Co., has indicated some additional exploration money has been earmarked for Nevada.

The dry hole was drilled about 40 miles north of Eagle Springs field, a four-well field opened by

(Continued on page 152)

F. B. (Bud) Neptune . . . 25 years of pipelining.

Pipelining's Family Affair

. . . for the Neptunes. F. B. Neptune and two of his brothers are executives in different pipeline firms.

WHEN F. B. "Bud" Neptune became president of the new Dixie LPG Pipe Line Co., another chapter was added to an unusual family history in pipelining.

Neptune is one of three brothers who are executives in pipeline companies. His brother Millard is a senior vice president of Texas Eastern Transmission Co., and heads that firm's Little Big Inch division. Another brother, Bill, is assistant treasurer of Kaneb Pipe Line Co.

All three are involved with products pipelines.

In addition to holding the helm at Dixie, Neptune is a director, executive vice president, and general manager of Phillips Pipe Line Co.

Phillips has a lengthy record in liquefied-petroleum-gas pipelining. Butane has been shipped through portions of its system since 1931. Since 1947, the company has been moving propane through its line from Borger, Tex., to Chicago.

Veteran pipeliner . . . Neptune will observe his 25th anniversary as a pipeliner this year. His first full-time pipeline job was as chief chemist for the Phillips products pipe line department at East St. Louis, Ill. That was in 1936.

East St. Louis was then the eastern terminal of the first long-distance pipeline designed and built to handle products.

When the line was extended to Chicago in 1939, Neptune was made that terminal's first superintendent. He left Chicago to go to Bartlesville in 1943 as assistant manager of the products pipe line department.

Later he became manager of the department, then manager of the pipeline division of the supply and transportation department. Finally he stepped up to his current place in Phillips management.

Pre-pipelining experience . . . Neptune had some contacts with production and petroleum engineering before he got into pipelining.

There was a 4-year gap between his graduation from high school and his entrance into college. Two of those years were spent with Phillips. Neptune worked as a roustabout in the Burbank field of Osage County, Oklahoma.

He spent the next 2 years with the Indian Territory Illuminating Oil Co., Bartlesville, Okla., doing production and engineering work.

Neptune resigned from ITIO in 1926 and entered the University of Oklahoma. To pay his way, he held down two jobs. As manager of a fraternity house, he kept books and served as treasurer. The other job involved keeping production curves for ITIO, which had leases in Osage County with a natural water flood.

In February 1931, Neptune graduated from OU with a BS in "oil-field management." This course, he says, was designed "for petroleum engineers who couldn't pass calculus."

Neptune was disappointed to learn that ITIO had no permanent job for him after his graduation.

Phillips took him on in its motor-fuel-research department. At first he ran routine tests on vapor pressure, distillation, and antiknock qualities.

When Phillips began to emphasize avgas research, he was assigned to that field. Between then and the time he left to go to East St. Louis, he wrote several papers on aviation and natural gasoline.

Neptune was born in Crookston, Minn. Except for a short residence in Washington, D. C., where his father was employed by the Government, and the 8 years in East St. Louis and Chicago, he and his family have lived in Bartlesville. He got both his elementary and high-school education there.

•

Edward H. Sickles, Jr., Indianapolis district manager for Mobil Oil Co., has joined Kerr-McGee Oil Industries as manager of the company's new eastern sales region. The region includes Indiana, Illinois, and Wisconsin. **John B. Hartnett** has been named manager of the new St. Louis sales district in Kermac's southern sales region.

Howard J. Speer, geologist with Aztec Oil & Gas Co. in Dallas, has been promoted to district geologist in Farmington, N. M.

Joseph S. Irwin, Jr., has joined Ashland Oil & Refining Co.'s Calgary division staff as geologist.

▶▶▶ Personals

Denis B. Kemball-Cook, Shell Oil Co.'s executive vice president for exploration and production and a director of the company, has been named executive vice president in charge of marketing, manufacturing, purchasing and stores, and transportation and supply. He will

KEMBALL-COOK

CLARK

also act as president's deputy. **J. E. Clark,** vice president for production, has been named to succeed Kemball-Cook as executive vice president, exploration and production. Clark also has been elected a director. The appointments are effective July 1.

Stanley L. Smith, manager of Atlantic Refining Co.'s West Texas-New Mexico region in Midland, Tex., has been named manager of the new Rocky Mountain district in Denver. **R. O. Childers,** Dallas, will move to Denver as drilling and production superintendent. **Thomas S. Pace** will be district land supervisor and **Thomas O. Davis, Jr.,** will be district engineer. Pace and Davis move to Denver from Casper, Wyo. **Leland G. Megason,** Corpus Christi, Tex., will be district geophysicist, Denver.

Carl D. Reese, Bridgeport, W. Va., division superintendent for Hope Natural Gas Co. has been named superintendent of production for the company. He succeeds **Arthur R. McCamey,** who retired June 1 after 46 years with Hope and its affiliates. McCamey had been production superintendent since 1953.

Robert E. Cain will join Southland Royalty Co., Fort Worth, later this month as chief geologist. Cain had been with Ramada Oil & Gas Co. in Corpus Christi. Southland Royalty's exploration operations formerly were handled by the late Junius H. Morrill, vice president in charge of exploration, who died April 10.

James Helis has been promoted to drilling and production section chief for Mobil Oil of Canada in Calgary. Helis formerly was with Mobil Oil Co. in Lafayette, La.

Walter W. Conners has been named crude-oil representative in Shell Oil Co.'s New Orleans area. He succeeds **T. B. Medders,** recently transferred to Denver.

Richard M. Knox, president of Knox Industries Corp. and Knox Hi Octane Corp., Enid, Okla., has been named manager of private-brand service stations for Kerr-McGee Oil Industries. He will continue as president of Knox companies.

G. H. Gossens, purchasing manager of Trans Arabian Pipe Line Co., and Mrs. Gossens have been cited by the U. S. Navy for meritorious public service. The citation was presented in Beirut by Vice Adm. **George W. Anderson, Jr.,** commander of the Sixth Fleet. The award was in recognition of special services to the Sixth Fleet and is the second highest award to civilians who are not Navy employes.

G. V. Rohleder, engineer for Mid-America Pipeline Co., has been elected president of the Pipe Liners Club of Tulsa. Other new officers include **D. A. Roach,** Mid-America, vice president; **W. A. Elliott,** Great Lakes Pipe Line Co., secretary; and **H. G. Mariner,** Service Pipe Line Co., treasurer. New directors are **Walter E. Biery,** Mid-Continent Pipe Line Co., Tulsa, and **F. B. Neptune,** Phillips Pipe Line Co., Bartlesville, Okla.

R. G. Zollars, mechanical engineer with Magnolia Pipe Line Co. in Dallas, has been promoted to division engineer in Plainfield, N. J.

Roy C. Patterson, superintendent of New York State Natural Gas Corp.'s northern division in Sabinsville, Pa., has been named manager of operating plans and budget. **Darwin E. Whipkey** has been named assistant superintendent of the company's Leidy district, Tamarack, Pa.

Andrew J. Betts, Midland, Tex., consultant, has joined Mississippi River Fuel Corp. as district geologist in the new Midland district office. **John D. Carey,** exploration and land manager in Wichita for Natural Gas & Oil Co., a division of Mississippi River Fuel, has been named manager of the Midland district land department.

Milo M. Brisco, executive vice president and a director of International Petroleum Co., has been elected president of the company. He succeeds **J. K. Jamieson,** recently named vice president and a director of Humble. **Zeb Mayhew,** deputy coordinator of producing activities for Standard Oil Co. (N. J.), will succeed Brisco as executive vice president and a director of International. **Henry F. Stevenson,** a director of International, has been named vice president and member of the executive committee. **Henry E. Winter,** executive representative in Venezuela, has moved to the company's executive offices in Coral Gables, Fla., as a director. **Mark F. Nero** will succeed Winter in Caracas. Brisco has been with International since 1935. He held assignments in Colombia and Peru before being named executive vice president in 1957.

BRISCO

W. H. Gibson, Texaco, has been elected president of the Geophysical Society of Houston. He succeeds **Paul Farren,** geophysical consultant. Other new officers include **Joseph W. Barbisch,** Quintana Petroleum Corp., and **Woodson M. Tottenham,** Mobil Oil Co., vice presidents; **R. R. Thompson,** Humble, secretary; and **Everett B. Miller,** Continental Oil Co., treasurer.

D. Joe Donovan, crude-oil representative for Ohio Oil Co. in Casper, Wyo., has been transferred to Houston as head of the crude-oil purchases and sales department there. **George N. Scott,** Los Angeles crude-oil representative, has been transferred to Casper as representative but will continue to coordinate crude-oil activities in Los

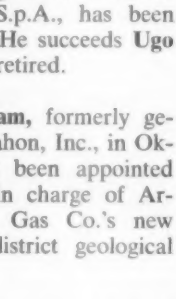
Angeles. **William S. Sargent,** Houston, will take over crude-oil purchases and sales operations in the Tulsa division. These operations had been handled by **Atwood A. Rosen,** who will continue as Terre Haute, Ind., division representative.

Derek F. Mitchell, vice president of BP (North America), has been named president of the company. He succeeds **D. E. C. Steel,** who has returned to British Petroleum's London head office as regional coordinator, Western Hemisphere. Mitchell was assistant general manager of BP's supply and development department in London before moving to New York in March.

Grant H. Headly, general manager and managing director of Mobil Oil Italiana S.p.A., has been elected president. He succeeds **Ugo Cantini,** who has retired.

Earl Cunnyngham, formerly geologist with McMahon, Inc., in Oklahoma City, has been appointed district geologist in charge of Arkansas Louisiana Gas Co.'s new Oklahoma City district geological office.

Will A. Rounds, regional land engineer for Continental Oil Co. in Fort Worth, has been promoted to regional coordinator of reserves and production acquisitions for the southwestern region. He will continue to headquarter in Fort Worth. Rounds succeeds **T. M. Cady,** who will retire June 30 after 24 years with Conoco. Rounds has been with the company since 1926 and had been Fort Worth land engineer since 1951.



ROUNDS

Waring Bradley, Anchorage consulting geologist, has been elected president of the newly organized Alaskan Independent Petroleum Association. Other officers are **John Shaw,** vice president; **George Grimes,** secretary; and **Harold Koslosky,** treasurer.

Everett Elliott, C. L. Elliott Co., Danvers, Mass., has been elected chairman of the board of National Oil Fuel Institute.

L. G. Hucks, managing director of BP (New Zealand), has been elected first chairman of New Zealand Refining Co. The company plans to build a 50,000 bbl. per day refinery in New Zealand.

Howard L. Cobb, Atlantic Refining Co., has been elected president of Dallas Geophysical Society. Other new officers are **Charles M. Moore, Jr.,** Geophysical Service, vice president; **Phillips L. Lawrence,** Mobil Oil Co., second vice president; and **John A. Waller,** Sun Oil Co., secretary-treasurer.

Dr. R. P. Arganbright has been named research specialist in Monsanto Chemical Co.'s Texas City plastics division research department. Arganbright was with Continental Oil Co. before joining Monsanto in 1956.

Rufino Gea has joined Aero Service (Bahamas) as manager of the ground-geophysics department. He had been with Geoprosco in Madrid, Spain.

William C. Albright, land group manager for Atlantic Refining Co.'s eastern Gulf Coast region, has been named Mid-Continent district manager. He will headquarter in Oklahoma City.

New appointments in Humble's headquarters marketing department, Houston, include **C. W. Bohmer, Jr.,** headquarters staff coordinator; **E. R. Smith,** head of marketing acquisitions; **R. M. Gray,** manager of advertising and sales promotion; **F. J. Hutchings,** credit coordinator; **G. V. Mallonee,** manager of retail-marketing development; **G. H. Shipley,** manager of industrial and specialties sales; and **A. P. Williams, Jr.,** manager of fuel-oil sales.

Thomas J. Flynn and **John M. Speak** of Sinclair Oil & Gas Co.'s New Orleans geological section, have been transferred to Lafayette, La.

Pat Wilson, project engineer with Texaco in New Orleans, has joined Atlantic Refining Co. in Port Arthur, Tex., as process engineer.

▶▶▶ Personals

BRAINARD

Guy R. Brainard, Jr., executive vice president of Drilling & Exploration Co., has been elected president. He succeeds **Charles R. Rider,** who becomes chairman. Brainard has been with Drilexco since 1956. He had been with Ohio Oil Co., Shell Oil Co., and Seaboard Oil Co. before that time. Rider had been president of Drilexco since 1957.

T. O. Allen, Jersey Production Research Co., Tulsa, has been named chairman of a new API subcommittee on Smithsonian exhibits. The committee will help organize an oil industry exhibit for the new Smithsonian Institution building in Washington. The building is scheduled to be opened early next year. Other committee members are **L. E. Elkins,** Pan American Petroleum Corp., Tulsa, vice chairman; **J. E. Eckel,** Jersey Production Research, executive secretary; and **M. P. Huntington,** Pan American, alternate secretary.

Sam H. Lloyd, vice president of Blue Water Drilling Corp., New Orleans, has been elected president. **H. F. Moses,** former president, has been named chairman and chief executive officer.

Dr. C. G. Clear, head of the lubricants general department at Shell Development Co.'s Emeryville, Calif., research center, has been named head of the new fuels and lubricants department.

E. J. Malovich will head the new Brisbane, Australia, office of Geophysical Service, Inc. Malovich will be responsible for the company's seismic and gravity-magnetic exploration activities in Australia.

J. E. Nichol has been named manager of chemical-development operations for Shell Oil Co. of Canada. He succeeds **C. C. McKenna,** who has joined the plastics and resins division of Shell Chemical Co. in New York.

Personals

Joe L. McArthur has been named area engineer for Pan American Petroleum Corp. in Ulysses, Kans. He succeeds **M. C. Gillis,** who has been transferred to the Tulsa general office.

John Dawson has resigned as senior geologist with Superior Oil Co. to open offices as consulting geologist in Casper, Wyo.

Suzanne Takken, senior exploration geologist for Mobil Oil Co., has been elected president of the Oklahoma City Geological Society. Other new officers are **Wilbur McMurtry,** consultant, vice president; **J. D. McDavid,** W. B. Osborne, Inc., treasurer; **Robert L. Scott,** consultant, secretary; and **Fred Smith,** Sinclair Oil & Gas Co., editor. Honorary membership in the group has been granted to **Hubert E. Bale,** Ada, Okla., consultant and producer; **Jerry Newby,** Oklahoma City consultant; and **Jerry Maddox,** Humble Oil & Refining Co.

John S. Cromie, assistant to the president of Catalytic Construction Co., Philadelphia, has been named to the new post of general manager. **Walter Cosinuke,** technical assistant to the manager of construction, has been named technical assistant to the president and **Charles H. Edmondson,** manager of Gulf Coast sales, has been named assistant manager of maintenance. **Thomas E. Workman** will succeed Edmondson.

Dr. James Lee Wilson, senior geologist for Shell Development Co., Houston, has been given a 1-year assignment with the Royal Dutch-Shell group's exploration and production laboratory in Rijswijk, near The Hague.

A. E. Fitkin has ben named president of National Gas & Oil Corp., Newark, Ohio. **R. A. Aukerman** has been elected vice president and chief geologist.

Leslie A. Webb, assistant to the president of Atlantic Refining Co., has been named manager of corporate planning services, a new position.

Philo C. Wilson, staff geologist with Sohio Petroleum Co. in Calgary, has joined Champlin Oil & Refining Co. as area geologist, Calgary.

Darrell G. Warner, production engineer for Humble Oil & Refining Co. in St. Elmo, Ill., has been given a temporary assignment as development foreman in Albion, Mich.

Donald Lynn Hall has been named vice president in charge of geology and exploration and a director of H. J. Gruy & Associates, Dallas petroleum and geological consulting firm. Hall was a geologist with Sinclair Oil & Gas Co. before joining Gruy in 1959.

Lester L. Cline, Billings, Mont., area land man for Humble Oil & Refining Co., has been named chief land man in the central region office, Tulsa. He succeeds **J. H. Marsh,** who retires July 1.

Edward S. Ferris has been named general manager of Arvida Oil Co., Florida marketing firm.

Robert W. Blair, formerly with Continental Oil Co. in Houston, has joined San Jacinto Oil & Gas Co. as chief geologist. He will headquarter in Houston.

Clovis E. Dyckman, chief engineer in charge of American Oil Co.'s estimating section in the general-engineering department, Whiting, Ind., has retired after 38 years with the company and its affiliates. Dyckman will be succeeded by **W. Wilson Bond.**

Deaths

Robert L. Rose, 49, vice president and a director of Drilling & Exploration Co., Inc., and president of its contract drilling subsidiaries, died May 12. Rose was with Union Oil Co. before joining Drilexco in 1944.

Thomas B. Lyons, 64, supervisor of the service and procedure section in Phillips Petroleum Co.'s gasoline department, Bartlesville, Okla., died May 26, at his home in Bartlesville. He had been with Phillips since 1923.

W. Hunter Atha, 93, president and general manager of Atha Oil Co. and Atha Supply Co., Zanesville, Ohio, before his retirement in 1940, died May 22 in Hendersonville, N. C. Atha's oil operations extended into Michigan and West Virginia as well as Ohio. He had lived in Delray Beach, Fla., since retirement.

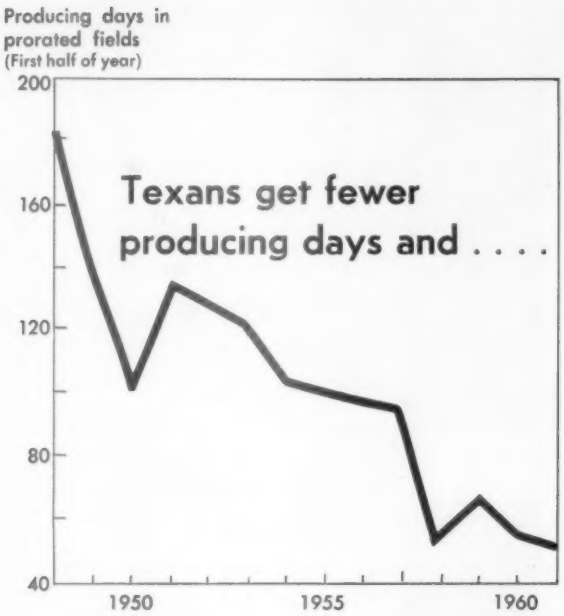
George M. McDonald, 65, retired special representative and provincial sales manager for Texaco Canada, died May 21 at his home in Toronto. McDonald retired last year after 36 years with Texaco.

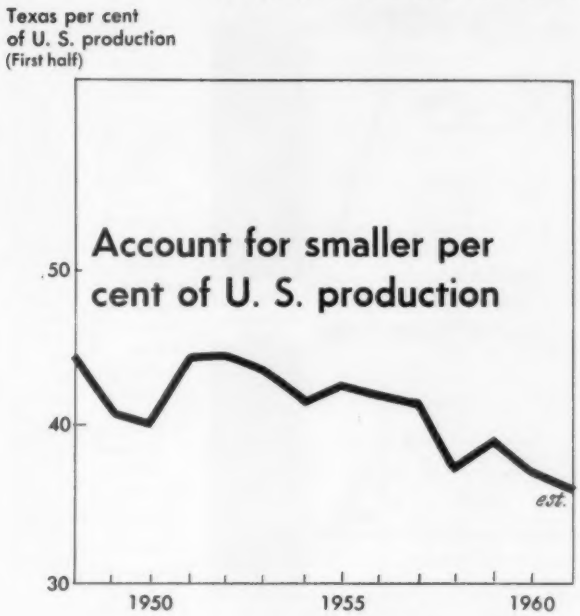
Allan H. Hand, 63, vice president of Consolidated Petroleum Terminal, Inc., a subsidiary of Oil Transfer Corp., died May 21 at his home in New York. During World War II, Hand served as assistant director of transportation under the federal petroleum coordinator and as secretary of the Petroleum Industry War Council. He was with Union Oil Co. and Ralph M. Parsons Co. before joining Consolidated.

Robert A. Brown, 45, northwest regional land manager for Phillips Petroleum Co., died May 29 in a Bartlesville, Okla., hospital after a year's illness. Brown had been with Phillips since 1937.

Arnold Ira Ritz, 63, laboratory technician at Pan American Petroleum Corp.'s Tulsa research center, died May 28 in a Tulsa hospital.

Earl R. Cobden, 54, director of purchasing for Hughes Tool Co. in Houston, died May 12 in New York City after a heart attack. He had gone to New York on business.





Producing days in Texas drop to new low

BY JOHN C. CASPER

TEXAS will have fewer producing days for the first half of this year than for any year in the past. The Railroad Commission started the year with 9 days for January, dropped to 8 for February, and moved up to 10 for March.

But stocks of Texas crude increased between 5 and 6 million barrels during March. April production was cut to 9 days. Texas crude stocks gained another 5 million barrels in April, and the commission cut May's production to 8 days for the 31-day month. Even at this low production rate, crude stocks increased for the first 3 weeks of the month. The Texas total for May 20 was 109,790,000 bbl. (See table on Page 147.) With stocks at a high level and little chance for a big jump in demand for crude, the commission held the June allowable at 8 days. These events all add up to 52 producing days for prorated fields in Texas for the first half of the year.

The chart on the left shows that the total for the first 6 months this year is a record low for the postwar period. It's more than that. The 52 days of production is the all-time low since Texas started controlling production through the use of shutdown days back in the thirties.

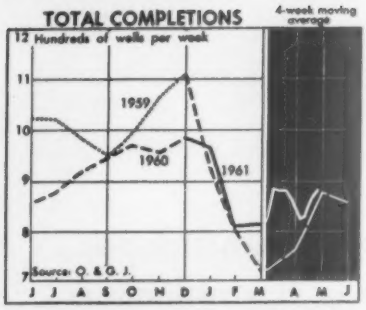
In recent years, the 8-day month for Texas has been considered by many producers as the irreducible minimum. There have been only 13 of these low-allowable months in Texas history, all of them in the past 4 years. The most severe cut came when the 8-day allowable hit on a 31-day month. There have been six of these rock-bottom months on record, including May this year.

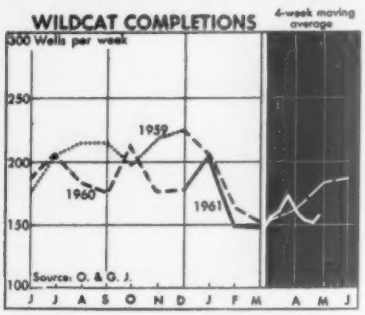
The chart on the right shows how these drastic reductions in number of producing days have changed the relative position of Texas as a producing state. The line pictures the Texas portion of total crude production in the first half of each year for the 1948-61 period. Texas accounted for better than 40% of the total until 1958. That was the year when first-half allowables dropped below 60 producing days. Texas production for the first half of this year is estimated at about 36% of the U. S. total, the smallest percentage since 1930.

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,074,725	DOWN	2,685	UP	231,369
Crude stocks	258,343,000	UP	4,403,000	DOWN	2,170,000
Completions	899	DOWN	106	UP	37
Refinery runs	8,049,000	UP	156,000	UP	150,000
Gasoline stocks	210,493,000	DOWN	3,199,000	DOWN	1,160,000
Kerosine stocks	27,154,000	DOWN	95,000	UP	2,733,000
Distillate stocks	90,259,000	UP	3,392,000	DOWN	1,194,000
Residual stocks	44,039,000	UP	649,000	UP	4,042,000
Four-product stocks	371,945,000	UP	747,000	UP	4,421,000
Total imports	1,709,400	DOWN	126,700	UP	136,300

Active Rotary Rigs





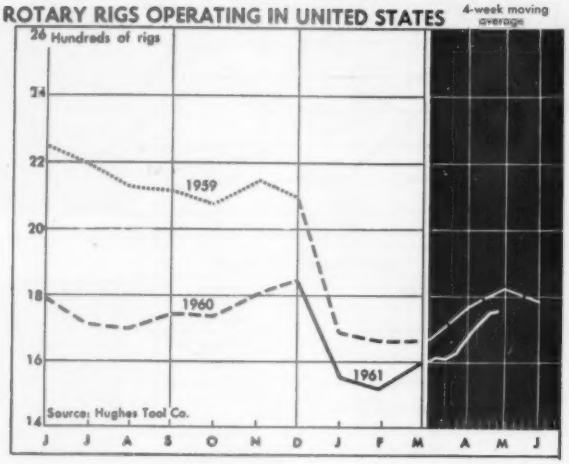
	5-29-61	5-22-61	5-30-60
Alabama	5	7	2
Alaska	10	9	5
Arkansas	8	9	11
Arizona	2	1	1
California	74	81	92
Land	69	75	88
Offshore	5	6	4
Colorado	31	25	29
Florida	0	0	1
Land	0	0	1
Offshore	0	0	0
Georgia	2	2	0
Illinois	36	29	43
Indiana	5	5	9
Kansas	94	116	128
Kentucky	2	2	5
Louisiana	288	286	285
North	26	28	36
S. Inland waters	111	115	109
S. Land	88	82	85
Offshore	63	61	55
Michigan	27	29	39
Mississippi	54	59	52
Missouri	1	1	3
Montana	23	28	21
Nebraska	30	37	27
New Mexico	119	116	121
New York	0	0	1
North Dakota	17	20	16
Ohio	8	7	6
Oklahoma	198	198	176
Oregon	0	0	1
Pennsylvania	7	6	11
South Dakota	1	1	1
Texas	641	654	626
S. Inland waters	7	8	6
S. Land	167	172	172
Offshore	2	2	1
North	64	66	48
Panhandle	56	57	48
East	91	82	54
West Central	150	165	190
West	104	102	107
Virginia	0	1	0
Utah	25	28	32
Washington	1	1	0
West Virginia	8	6	4
Wyoming	42	39	59
Total U. S.	1,759	1,803	1,807
Cum. avg. to date	1,622	1,615	1,730
Western Canada	113	81	123
Eastern Canada	0	0	2
Grand total	1,872	1,884	1,932

Hughes Tool Co. report.

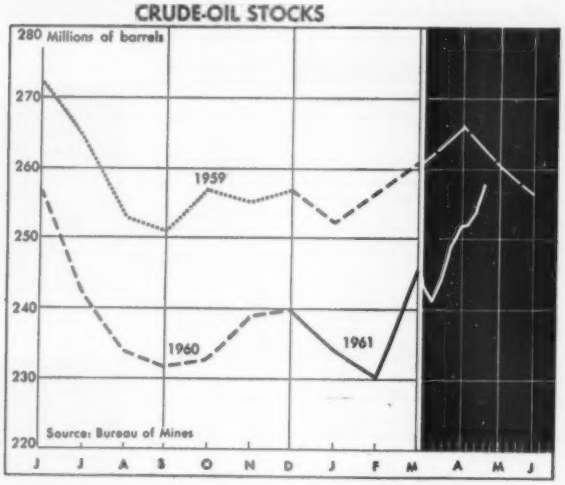
WEEKLY WELL COMPLETIONS . . . WEEK ENDED MAY 27, 1961

	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1961	1960	Total	Crude	Cond.	Gas	Dry	1961	1960
Alabama	1	0	0	0	1	0	4,058	27	22	1	0	0	0	1	6	1
Alaska	1	1	0	0	0	0	11,048	16	.....	0	0	0	0	0	2	.....
Appalachian	15	1	0	10	4	0	38,908	837	680	0	0	0	0	0	26	18
Arizona	1	0	0	0	1	0	3,020	10	7	1	0	0	0	1	7	7
Arkansas	7	1	0	1	5	0	30,158	217	245	3	0	0	0	3	41	60
California	37	25	0	2	10	0	177,695	690	543	7	0	0	0	7	112	121
Colorado	10	0	0	2	8	0	42,097	266	264	4	0	0	0	4	127	126
Illinois	33	19	0	0	14	0	81,760	689	780	9	3	0	0	6	142	192
Indiana	13	4	0	0	7	2	20,261	241	365	2	0	0	0	2	71	146
Kansas	161	81	0	11	55	14	323,265	2,190	1,308	24	5	0	1	18	396	437
Kentucky	38	6	0	17	15	0	74,418	594	654	1	0	0	0	1	63	77
Louisiana	78	31	9	6	32	0	610,602	1,459	1,351	18	3	0	0	15	226	196
North	31	13	0	3	15	0	110,257	503	436	9	2	0	0	7	88	83
South	40	14	7	2	17	0	428,898	736	692	9	1	0	0	8	121	100
Offshore	7	4	2	1	0	0	71,447	220	223	0	0	0	0	0	17	13
Michigan	15	1	0	0	14	0	48,959	272	295	7	0	0	0	7	109	91
Mississippi	12	5	0	1	6	0	121,759	222	299	4	0	0	0	4	71	95
Montana	4	1	0	0	3	0	25,498	150	103	3	0	0	0	3	69	47
Nebraska	27	16	0	0	11	0	120,666	381	327	11	1	0	0	10	161	124
New Mexico	60	41	0	8	11	0	200,676	730	733	6	1	0	0	5	128	107
West	41	29	0	8	4	0	115,199	313	239	1	1	0	0	0	42	22
East	19	12	0	0	7	0	85,477	417	494	5	0	0	0	5	86	85
North Dakota	4	1	0	0	3	0	23,807	99	127	0	0	0	0	0	27	26
Ohio	17	10	0	1	4	2	49,325	409	428	2	0	0	0	2	20	24
Oklahoma	55	24	0	1	21	9	95,452	2,424	1,578	0	0	0	0	0	247	303
Texas	275	147	7	20	93	8	1,095,844	5,730	6,510	38	0	0	0	38	1,147	1,314
District 1	9	3	0	0	6	0	19,169	347	453	4	0	0	0	4	120	155
District 2	11	3	1	1	6	0	62,761	279	308	2	0	0	0	2	60	73
District 3	12	5	0	2	5	0	61,978	428	502	1	0	0	0	1	86	94
District 4	28	10	2	1	15	0	161,004	485	472	5	0	0	0	5	110	133
East	14	8	1	0	5	0	71,694	460	494	3	0	0	0	3	104	105
District 7-B	30	7	1	4	17	1	91,081	810	948	10	0	0	0	10	219	266
West	76	54	1	1	16	4	371,176	1,428	1,717	11	0	0	0	11	304	285
District 9	65	42	1	0	19	3	147,176	969	1,213	2	0	0	0	2	103	175
District 10	30	15	0	11	4	0	109,805	524	403	0	0	0	0	0	41	28
Utah	4	1	0	0	3	0	22,675	107	117	2	0	0	0	2	44	42
Wyoming	30	12	0	2	16	0	125,148	408	394	13	0	0	0	13	151	166
Misc. (Ore.)	1	0	0	0	1	0	5,716	87	56	1	0	0	0	1	81	45
Total U. S.	899	428	16	82	338	35	3,352,815	18,255	17,186	157	13	0	1	143	.....	3,765
Total prev. week	1,005	406	22	111	346	120	3,863,695	.....	.....	189	11	4	16	158	.....	.....
Cum. 1961	18,255	8,326	399	1,777	6,527	1,226	73,740,335	.....	.....	3,474	274	43	163	2,994	.....	.....
Cum. 1960	17,186	8,096	544	1,410	6,643	493	75,451,807	.....	.....	3,765	342	41	126	3,256	.....	.....
Western Canada	14	9	0	1	4	0	72,727	873	872	5	0	0	0	5	261	261

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	5-20-61	5-13-61	5-21-60
Pennsylvania	2,319	2,288	2,178
Other Appalachian	1,501	1,440	1,675
Illinois, Indiana, Michigan	10,036	9,797	9,643
Nebraska and North Dakota	3,268	2,955	2,686
Kansas	9,701	9,510	10,224
Oklahoma	17,230	17,233	17,836
Arkansas	2,152	2,189	1,943
Louisiana	21,377	21,661	19,265
North	3,421	3,479	3,398
South	17,956	18,182	15,867
Mississippi, Alabama, Florida	1,889	2,023	2,243
New Mexico	8,239	7,707	7,657
Texas	109,790	108,716	111,606
East Texas	8,903	8,791	9,033
West Texas	49,665	49,802	50,854
Texas Gulf	19,244	19,808	19,301
Other Texas	31,978	30,315	32,418
Wyoming	19,196	18,611	18,122
Other Rocky Mountain	9,410	9,463	9,701
California	25,020	25,633	28,702
Foreign	†17,215	14,714	17,032
Total	**258,343**	253,940	260,513

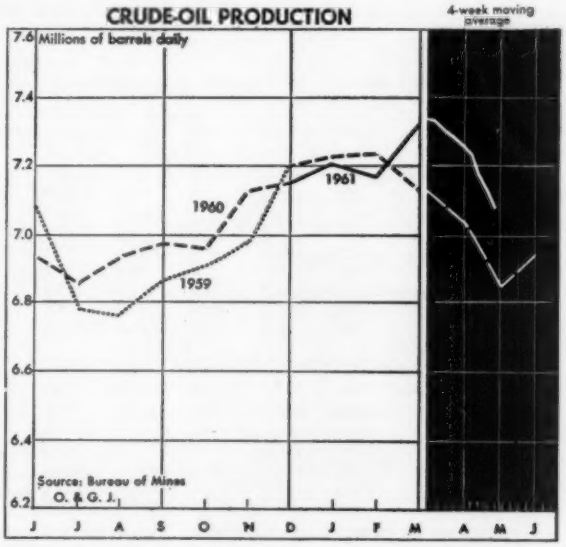
*Bureau of Mines. †Includes 5,353,000 bbl. in California.

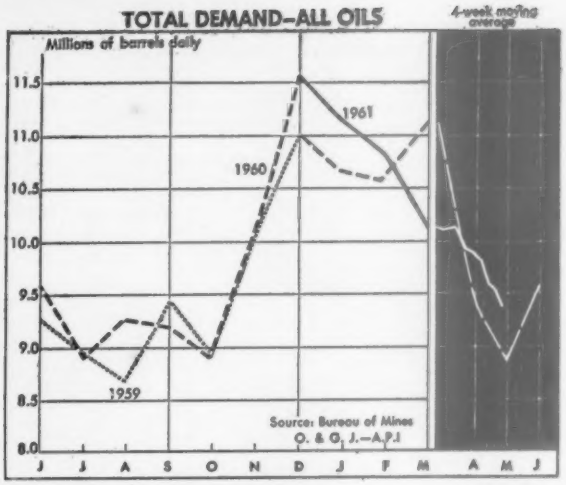
DAILY AVERAGE PRODUCTION FOR WEEK

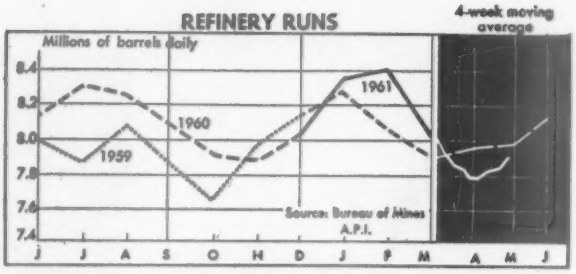
	May 27, 1961 Crude oil	Lease condensate	Total	May 20 total
Alabama	19,350	.....	19,350	19,300
Alaska	13,500	.....	13,500	13,000
Arkansas	80,875	125	81,000	80,925
California	826,500	.....	826,500	826,500
Colorado	130,800	.....	130,800	131,800
Eastern	41,000	.....	41,000	40,300
Florida	1,100	.....	1,100	1,100
Illinois	211,300	.....	211,300	207,800
Indiana	29,900	.....	29,900	30,000
Kansas	†316,550	.....	†316,550	†309,310
Kentucky	49,100	.....	49,100	49,200
Louisiana	1,020,050	142,750	1,162,800	1,162,700
North	105,050	5,250	110,300	110,200
South	915,000	137,500	1,052,500	1,052,500
Michigan	51,900	.....	51,900	52,700
Mississippi	146,000	4,200	150,200	150,200
Montana	82,400	.....	82,400	83,000
Nebraska	66,800	.....	66,800	67,000
Nevada	450	.....	450	450
New Mexico	310,000	7,300	317,300	317,300
North Dakota	55,100	.....	55,100	58,000
Oklahoma	†529,500	.....	†529,500	†538,500
Texas	2,355,000	93,350	2,448,350	2,448,350
Dist. 1	43,000	2,400	45,400	45,400
Dist. 2	97,000	8,400	105,400	105,400
Dist. 3	298,000	39,000	337,000	337,000
Dist. 4	167,000	13,800	180,800	180,800
Dist. 5	26,000	600	26,600	26,600
Dist. 6	104,000	8,400	112,400	112,400
East Texas field	124,000	.....	124,000	124,000
Dist. 7-B	120,000	400	120,400	120,400
Dist. 7-C	108,500	3,150	111,650	111,650
Dist. 8	977,000	11,000	988,000	988,000
Dist. 9	190,000	3,800	193,800	193,800
Dist. 10	100,500	2,400	102,900	102,900
Utah	95,400	.....	95,400	97,600
Wyoming	393,800	.....	393,800	391,700
Oothers	‡625	.....	‡625	‡675
Total U. S.	6,827,000	247,725	**7,074,725**	7,077,410
Change from prev. week, down			**2,685**	.....
Canada	†638,800	.....	†638,800	†636,000
Total U. S. Prod.—Jan. 1-May 27			1,064,264,000 bbl.	
Same period last year (crude plus cond.)			*1,051,179,000 bbl.	

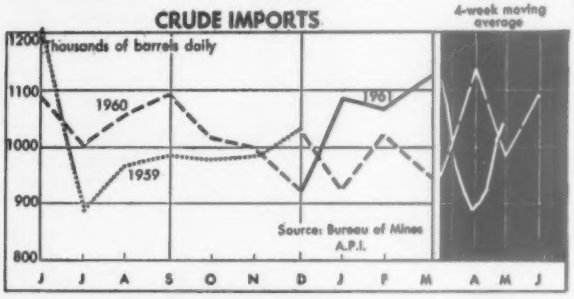
*Includes 34,453,700 bbl. condensate. †Week ended previous Monday. ‡South Dakota and Arizona.

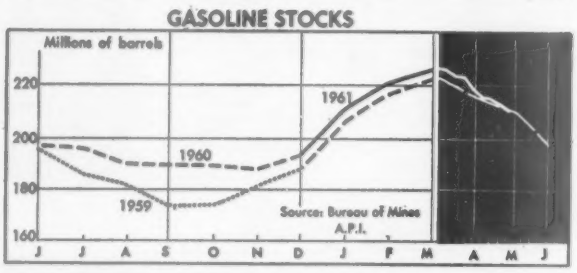
CRUDE-OIL PRODUCTION

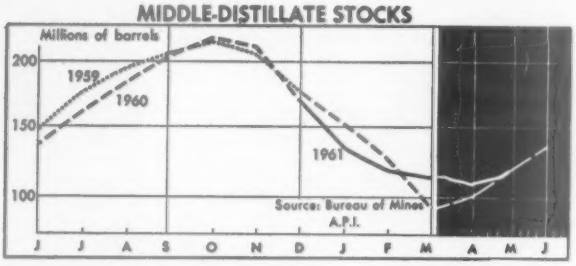


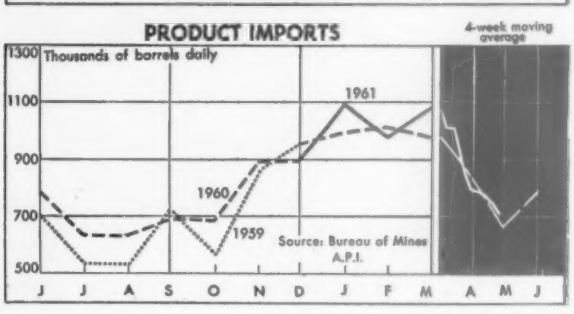


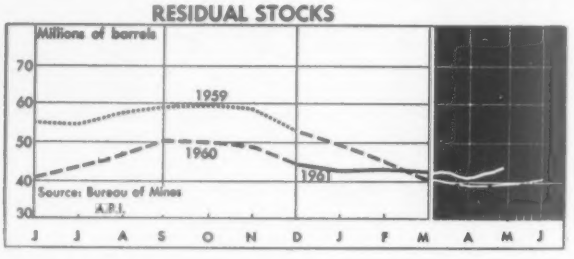












API REFINERY REPORT, MAY 26, 1961

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.	Kero.	Dist.	Resid.	Bureau of Mines, May 1960 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,102	526.6	29.3	303.9	131.7	49,520	10,237	26,901	10,772	1,129	490.9	31.7	317.3	149.4
Appalachian:														
District 1	97	40.6	3.8	22.1	6.7	6,233	649	1,832	407	97	39.0	3.6	21.4	7.6
District 2	100	54.0	5.0	19.9	12.0	3,283	436	1,094	345	74	43.9	1.1	15.4	5.7
Ind., Ill., Ky.	1,422	719.6	56.6	266.1	145.3	37,699	4,642	15,242	5,164	1,424	734.4	66.9	283.7	136.3
Minn., Wis., Dak.	96	41.1	2.0	21.7	17.7	6,653	587	3,416	633	120	57.9	4.4	29.7	15.8
Okla., Kans., Mo.	677	397.3	18.8	154.9	21.1	18,731	1,359	9,238	1,005	692	381.8	16.6	157.2	20.7
Inland Texas	320	220.3	15.1	51.3	18.6	7,749	541	1,597	2,627	291	213.1	8.0	48.5	18.5
Texas Gulf Coast	1,863	1,011.3	78.7	514.4	133.0	28,774	3,270	10,347	4,989	1,890	952.8	101.5	426.5	128.2
La. Gulf Coast	682	391.3	18.0	192.0	38.3	11,123	2,697	4,344	1,266	680	348.4	41.2	158.3	41.8
N. La. and Ark.	116	69.3	5.6	27.1	5.0	5,964	843	1,790	125	110	65.0	5.8	22.9	4.4
Rocky Mountain:														
New Mexico	25	12.3	0.6	5.4	2.6	817	66	199	39	24	11.8	0.5	4.1	2.6
Other Rocky Mt.	285	137.6	1.9	63.4	34.4	7,724	388	2,423	896	244	118.0	2.1	60.0	30.0
West Coast	1,264	534.3	13.3	208.1	279.6	26,223	1,439	11,836	15,771	1,188	532.0	34.4	191.8	280.0
May 26, 1961	8,049	4,155.6	248.7	1,850.3	846.0	210,493	27,154	90,259	44,039	7,963	3,989.0	317.8	1,736.8	841.0
May 19, 1961	7,893	4,111.9	241.9	1,670.7	897.6	213,692	27,249	86,867	43,390	.....	.....	.....	.....	.....
May 27, 1960	7,899	4,093.4	332.0	1,757.9	900.6	211,653	24,421	91,453	39,997	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Oklahoma	West Tex. (sour)	West Tex. (Inter.)	No.* Texas	Texas Refugio Light	Bayou Sale (La.)	Denver Julesburg	Wyo. (sour)
14-14.9	$1.86	....	....	....	....	....	....	....	....
15-15.9	1.93	....	....	....	....	....	....	....	$1.81
16-16.9	2.00	....	....	....	....	....	....	....	1.86
17-17.9	2.06	....	....	....	....	....	....	....	1.91
18-18.9	2.13	....	....	....	....	....	....	....	1.96
19-19.9	2.20	....	(†)	....	....	....	....	....	2.01
20-20.9	2.27	$2.49	$2.35	$2.61	$2.29	$2.95	$2.90	$2.58	2.06
21-21.9	2.33	2.52	2.38	2.63	2.33	2.97	2.92	2.60	2.11
22-22.9	2.40	2.55	2.41	2.65	2.37	2.99	2.94	2.62	2.16
23-23.9	2.46	2.58	2.44	2.67	2.41	3.01	2.96	2.64	2.21
24-24.9	2.53	2.61	2.47	2.69	2.45	3.03	2.98	2.66	2.26
25-25.9	2.60	2.64	2.50	2.71	2.49	3.05	3.00	2.68	2.31
26-26.9	2.67	2.67	2.53	2.73	2.53	3.07	3.02	2.70	2.36
27-27.9	2.74	2.70	2.56	2.75	2.57	3.09	3.04	2.72	2.49
28-28.9	2.81	2.73	2.59	2.77	2.61	3.11	3.06	2.74	2.54
29-29.9	2.87	2.76	2.62	2.79	2.65	3.13	3.08	2.76	2.59
30-30.9	2.93	2.79	2.65	2.81	2.69	3.15	3.10	2.78	2.63
31-31.9	3.00	2.82	2.68	2.83	2.73	3.17	3.12	2.80	2.67
32-32.9	3.06	2.85	2.71	2.85	2.77	3.19	3.14	2.82	2.71
33-33.9	3.12	2.88	2.74	2.87	2.81	3.21	3.16	2.84	2.75
34-34.9	3.17	2.91	2.77	2.89	2.85	3.23	3.18	2.86	2.79
35-35.9	3.22	2.94	2.80	2.91	2.89	3.25	3.20	2.88	2.83
36-36.9	3.27	2.97	2.83	2.93	2.93	3.27	3.22	2.90	2.87
37-37.9	3.31	2.99	2.86	2.95	2.95	3.29	3.24	2.92	2.89
38-38.9	....	3.01	2.89	2.97	2.97	3.31	3.26	2.94	2.91
39-39.9	....	3.03	2.92	2.99	2.99	3.33	3.28	2.96	2.93
40-44.9	....	3.05	2.95	3.01	3.01	3.35	3.30	2.98	2.95

*Cooke, Grayson, Montague. †Two buyers announced increase.

FLAT PRICES

Louisiana:	
Sweet Lake	$3.00
Texas:	
East Texas	3.05-3.25
Conroe	3.23-3.53
Van	3.08
Pennsylvania Grade:	
Bradford	$4.80
Middle District	4.52
Southwest Pennsylvania	4.25
West Virginia	4.17
Buckeye Grade	4.08
Illinois Basin	**3.00-3.05**

FOREIGN

Middle East, Persian Gulf: (cargoes f.o.b. lifting port)	
Arabian, 34.0°-34.9°, Ras Tanura	$1.80
Iranian, 34.0°-34.9°, Bandar Mashur	1.78
Iranian, 34.0°-34.9°, Abadan	1.73
Iraq, 35.0°-35.9°, Fao	1.72
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.59
Qatar, 41.0°-41.9°, Umm said	1.95
Middle East, E. Mediterranean:	
Arabian, 34.0°-34.9°, Sidon	$2.17
Iraq, Mosul-Kirkuk, 35.0°-35.9°, Tripoli	2.19
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 36°	2.42
Canada:	
Leduc-Woodbend	$2.53
Redwater (Alta.)	2.42
Weyburn (light)	2.06
Midale C	1.70
Venezuela:	
Cumarebo, 47°-47.9°, Tucupido	3.34
San Joaquin, 40°-40.9°, Puerto La Cruz	3.08
Oficina, 35°-35.9°, Puerto La Cruz	2.80
Tia Juana medium, 26°-26.9°, Amuay*	2.30
Quiriquire, 16.0°-16.4°, Caripito	2.10
Lagunillas heavy, flat, Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

TANKER RATES (Long Ton)

(Latest reported spot fixtures)

★ Gulf-NY, dirty (ATRS—5%)	$ 2.71
★ Carib.-UKC, clean (Scale—47.5%) (17s. 1d.)	2.46
★ Carib.-NY, dirty (ATRS—60%)	1.10
PG-UK, dirty (Scale—68%) (21s. 7d.)	3.02
★ PG-Japan, dirty (USMC—73%)	2.75

★Denotes change from previous week.

REFINED PRODUCTS

Following quotations are realistic spot prices for refined products moving interstate on Wednesday each week. They may differ from refiners' posted prices and should not be considered as postings.

Light-product prices are in cents per gallon. Residual and crude prices are dollars per barrel. Crude prices are at the well unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (91 octane)	11.25-11.50
Premium (99 octane)	14.00-14.25
Natural gasoline (26-70)	4.5
Breckenridge	4.0
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.50-11.00
Regular (92 octane)	10.75-11.25
Premium (98 octane)	11.75-12.25
California (rack) Los Angeles:	
Regular (90 octane)	11.60
Premium (94 octane)	12.60
Premium (100 octane)	14.10
Caribbean area (cargoes):	
Regular (87 octane)	9.125
Premium (97 octane)	11.50

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	9.50-10.00
Diesel oil (58 d.i. and above)	9.25-9.50
Distillate No. 1	9.25-9.50
Distillate No. 2	8.25-8.50
Gulf Coast (cargoes):	
Kerosine 41-43	9.25-9.50
Distillate No. 2	8.25-8.75
New York Harbor (barges):	
Kerosine 42-43	*11.40
Distillate No. 2	*10.40
Diesel fuel, 48-52 d.i.	*10.55
Caribbean area (cargoes):	
Distillate No. 2	8.625

*Subject to 0.5 cent discount.

RESIDUAL FUEL (Bbl.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.65-1.75
Gulf Coast (cargoes):	
Bunker C fuel	2.10-2.20
New York Harbor (barges):	
Bunker C fuel	2.52
Caribbean (cargoes):	
Bunker C fuel	2.00
California (rack):	
Bunker C fuel, Los Angeles	2.25

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1,000	100 PSI	50 PSI	1,025	75 PSI	100 PSI NEW		STEEL	
890	100 PSI	75 PSI	665	100 PSI	236 PSI	2,240	840 PSI	260 PSI
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FOR SALE EQUIPMENT

FOR SALE: National Tank Company LTX Unit, Serial #133, Built 1951 W.P. 1200#, Capacity 5 MMCF, with Foxboro Model 40 Stabilog Temp. Controller, Serial #J52455. FOB location, Hidalgo County, Texas. $2,500.00. Contact: Bob Miner, 207 Sun—Texaco Building, Corpus Christi, Texas.

FOR SALE:
Abandoning machine mounted on semi-trailer. Skid Mounted. Can be removed from trailer very easily. Complete with hydraulic jacks and many tools. The Oil Tool Corporation, 3075 Cherry Avenue, Long Beach 7, Calif.

USED QUICK-CYCLE Hydrocarbon Recovery and gas dehydration units: 12 MM to 27MM SCFD capacities 100# W.P.—turn-key installations. Other used gas processing equipment available including absorption and fractionation towers, vessels, furnaces, etc. Also gas dehydrators, glycol type. Engineered Specialties Co. Box 35683, Phone FL 1-5284, Dallas, Texas.

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Write for Equipment Inventory
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This equipment to be sold in place, as is, for dismantling and removal at expense of buyer. For appointment to inspect, contact.

Otis P. Addington, General Manager
Haynesville Operators Committee
Telephone 300
Haynesville, Louisiana

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1 MODEL-D SONOLOG well sounder. Used approximately 10 hours. $2,200.00 F.O.B. Post Office Box 323, Jackson, Miss.

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Modern 15,000 BSD Fixed Bed HYDROFORMER

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Write for Inventory
Send Us Your Requirements

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60 East 42nd St., New York 17, N. Y.
310 Thompson Bldg., Tulsa, Okla.

EQUIPMENT WANTED

WANTED—OIL Country Lathe with 7 or 8 inch hole in spindle. Give make, condition, price and location in first letter. Drillers Supply Company, Box 64, Joplin, Missouri.

HELP WANTED

NATURAL GAS Engineer with engineering degree plus 3 to 5 years experince in plant design or operation for work in the Gulf Coast Area. Amerada Petroleum Corp., Gas Department, P. O. Box 2040, Tulsa, Oklahoma.

HELP WANTED

EXPANDING INDEPENDENT, requires 6-10 years experienced reservoir engineer competent in miscible, water, gas drives, and unit engineering committee work. Box 929, Tyler, Texas.

CASINGHEAD GASOLINE plant foreman needed by independent oil company. Please state qualifications, references. Replies confidential. Box M-415, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER for sales work. Houston Manufacturer of gas lift and oil-field production equipment. Give resume of experience. Our employees know of this ad. Box M-418, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER: To manage production department and handle drilling program. Must have California experience. Salary commensurate with ability. Bolsa Chica Oil Corporation, 612 South Flower Street, Los Angeles—MAdison 9-2578.

OIL JOB DIRECTORY, foreign and domestic, showing where to apply for jobs. $5.00 cash OIML Co., Box 2603, Tulsa, Oklahoma.

SITUATIONS WANTED

MECHANICAL ENGINEER 36, B.S., family, 12 years refinery and petrochemical design, maintenance, construction. Presently overseas, available August. Box M-413, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY Superintendent—Engineer: 39, 17 years varied experience in refinery process design, construction, maintenance and operation. Registered, engineer in Texas and Oklahoma. Box M-404, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER, with twenty years experience including all phases drilling, production, pipeline, engineering and geological evaluatings. Good background in administration and management including budgets, forecasts, economic evaluations, explorations and exploitation. Desire position with progressive independent or small producing firm. Registered. Box M-400, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER, 37, extensive and varied experience in production, drilling and water flooding. Domestic with major company, foreign with independent. Now doing consulting work. Desire position with active independent or drilling company foreign or domestic. Box M-419, The Oil and Gas Journal, Tulsa 1, Oklahoma.

CHEMICAL ENGINEER: 32, 6 years diversified experience (Drilling, workovers, budgets, forecasts, production, reservoir, evaluations) with major in South America. Will relocate anywhere in U. S. Resume on request. Box M-422, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER: B.S. Petroleum. Single, relocate foreign, domestic. Consider any job with promising future. Two years drilling, production, reservoir, logging, IBM. Presently employed. Box M-424, The Oil and Gas Journal, Tulsa, Oklahoma.

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HAVE YOU PLUGGED A PRODUCER?
Micro-Fluorologs prepared from your well cuttings will determine oil bearing stratas drilled through, and will indicate oil stratas at greater depth not yet drilled. Effective on old well samples or while being drilled. Logs: $100 per 1000 ft. Information:
PetroCo, Box 882, Casper, Wyoming

HELP WANTED

GEOLOGIST

Our Service has been selected by a small oil company with expansion program, to recruit and screen candidates for the above position which offers a fine opportunity for a successful man. Requires 8 or more years experience in South Texas and Louisiana Gulf Coast area, with an independent company desirable. Ability to meet public. Submit Resume. Salary $10,000 Fee Paid.

QUINBY
EMPLOYMENT SERVICE
406 Bankers Mortgage Bldg. Houston, Texas

BUSINESS SERVICE

DELAWARE CORPORATION formed and serviced American Guaranty & Trust Company. P. O. Box 487, Wilmington, Delaware.

MONEY RAISING

HAVE COMPLETED two nice wells since first of year. Have three more proven leases to drill. Would like three partners to complete drilling and producing project for 1961. Ready to drill another well now. S & M Drilling & Production Co., Box 59, Cherryvale, Kansas.

WANTED—CAPITAL to help develop a 25 million dollar placer gold mine. Qualified Engineer's report available to interested parties. C. L. Craig, Box 790, Plainview, Tex.

BUSINESS OPPORTUNITIES

INDEPENDENT Producer desires associates to join in proven shallow drilling programs this year on a cost basis. For Particulars. Write: Box 589, Independence, Kansas.

FINANCIAL—Investment Banking Houses and Underwriters reached. Confidential. You can send the details of your proposition direct or thru your attorney to Consultant 817—51st Street, Brooklyn, N. Y.

NEED RETIRED Geologist to do geology work on an interest basis. For further information write: Manuel Rudy, 3818 Canal Street, Houston, Texas.

DISTRIBUTORS WANTED—For Masterseal line of lost circulation products, Masterseal, Masterbridge, Masterplug, and Masterfiber. Good areas still open. Masterseal Sales Corporation, Box 1501, Ventura, California.

LEASE AND DRILLING BLOCKS

CAMBRIDGE ARCH, Neb., Active operator seeks associate to develop a number of lease blocks. Some small acreage in Red Willow County. Others expand to several thousand acres, adjacent counties. Box M-411, The Oil and Gas Journal, Tulsa, Oklahoma.

INDEPENDENT production company leasing acreage in Ohio and West Virginia has 5,000 to 15,000 acre blocks. Excellent earning potential for small investors. Write or call: Ohio-West Virginia Production, Box 393, Marietta, Ohio. FR 3-6862.

DO YOU HAVE A LEASE TO SELL? For as little as $5 per week you can tell your proposition to over 45,000 oil men through The Journal's classified advertising pages. You'll be surprised how many are interested.

FOR SALE: Overriding royalty in San Juan County, New Mexico. Write Box M-420, The Oil and Gas Journal, Tulsa, Oklahoma.

HAVE 100,000 ACRES of Ohio and West Virginia Oil and Gas Leases in Appalachin Basin Area for immediate sale in the Multa Million acre lease play scattered in and through major companies holdings, specializing in 50 to 60 thousand acre blocks. David Law, 716 Union Trust Building, Parkersburg, West Virginia.

ELLSWORTH COUNTY, KANSAS (640 acres). Drilling Contractor seeks associates to drill a 3,400 ft. test in subsurface or seismograph structure which is ½ mile north of Arbuckle oil pool that has produced 1,286,000 bbls. of oil from 16 wells. Box M-423, The Oil and Gas Journal, Tulsa, Oklahoma.

LEASES, DRILLING BLOCKS, good gas area, Eastern Oklahoma. Excellent geology. Can operate if required. Box M-426, The Oil and Gas Journal, Tulsa, Oklahoma.

ROYALTIES

ATTRACTIVE ROYALTY buys, large gas area, near pipelines. Drilling in 60 days. Box M-427, The Oil and Gas Journal, Tulsa, Oklahoma.

LEGAL

NOTICE IS HEREBY GIVEN that 29 tracts, comprising 8,408.72 acres of Tribal lands on the Wind River Reservation, Fremont County, Wyoming, are offered for competitive oil and gas leasing, under Oil and Gas Lease Sale No. 5, through sealed bids to the qualified bidder of the highest cash bonus offer per acre. Bids will be opened at 2:00 P.M., Mountain Standard Time, July 17, 1961, in the office of the Superintendent, Wind River Agency, Fort Washakie, Wyoming. Full details of the offering and how and where to submit bids may be obtained from the Superintendent, Wind River Agency, Fort Washakie, Wyoming. F. W. Pederson, Acting Superintendent.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Denver Colorado. Notice is hereby given that 840 acres of land in three parcels within the known structure of the Bell Rock Field, Moffat County, Colorado will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre at 2 p.m., M.S.T., July 26, 1961, when bids will be opened. Details of the lease offering, how and where to submit bids, and forms for bidding, may be obtained from Dale R. Andrus, Land Office Manager, P. O. Box 1018, Denver 1, Colorado.

LEGAL

SEALED BIDS will be received until 10:00 A.M. Mountain Standard Time, June 9, 1961, and opened at that time in the office of the Navajo Indian Agency, Window Rock, Arizona, for oil and gas leases on 3 tracts of Tribal lands, totaling approximately 840 acres, located in San Juan County, Utah.

Details of the lease offering and filing of bids may be obtained by addressing an inquiry to the General Superintendent, Navajo Indian Agency, Attention: Branch of Realty, Window Rock, Arizona.

LEGAL

SALE OF OIL AND GAS MINING LEASES, TRIBAL INDIAN LANDS, Department of the Interior, Bureau of Indian Affairs, Uintah and Ouray Agency, Fort Duchesne, Utah.

SEALED BIDS will be received until 2:00 P.M. Mountain Standard Time, July 6, 1961, and opened at that time in the office of the Uintah and Ouray Agency, Fort Duchesne, for leasing of 30,450.88 acres of Tribal Indian lands, located in Townships 4 and 5 South, Ranges 8, 9 and 10 West, Uinta meridian, Duchesne and Wasatch Counties, Utah, for oil and gas mining purposes. Details of the lease opening and how and where to file bids may be obtained by addressing an inquiry to the Superintendent, Uintah and Ouray Indian Agency, Fort Duchesne, Utah.

More exploration news

(Continued from page 140)

Shell Oil Co. in 1954 (OGJ, Apr. 17, p. 155).

Confirmation test due at S. W. Oklahoma strike

A 6,000-ft. confirmation wildcat was announced by Woods Exploration Co. and Peake Petroleum Co. at 1 Zimpel in C SW SE 31-4n-9w, 1 mile north of new production near Sterling in Comanche County, southwestern Oklahoma.

The well will attempt confirmation of 1 Meade, discovery well in C SW SE 6-3n-9w. That Rowe Springer sand discovery flowed 3,700 M.c.f.d. from perforations at 5,827-37 ft. It also made 5,300 M.c.f.d. on 36/64-in. choke from perforations at 5,868-78 ft. Operators are completing.

Kingfisher County. Continental Oil Co. completed a Meramec Mississippian oil confirmation 1 mile southeast of the discovery well at West Hennessey field.

The 1 Paul W. Murray, C SE NW 22-19n-7w, flowed 828 bbl. per day on 20/64-in. choke from open hole at 7,067-7,158 ft. The discovery well was Cabeen Exploration Co. et al. 1 Reiswig, C NE NW 21-19n-7w. That well flowed gas-condensate from both Manning and Meramec.

Keener Oil Co. completed 1 Ratcliffe in C SE NE 3-17n-5w, flowing 213 bbl. per day on 20/64-in. choke from Meramec open hole at 6,505-94 ft. Location is 1½ miles south of Columbia field.

Big gas well to be offset in California

Location has been staked for a stepout ½ mile east of one of the biggest gas wells ever completed in the Sacramento Valley.

McCulloch Oil Corp. will take its 1 McCulloch-Soite to 4,500 ft. in an effort to find the same Domengine sands which were so prolific in the 1 McCulloch-Duarte. The 1 Duarte had an open-flow potential of 170 M.M.c.f.d. when tested late last year. The flow was from thick zones, one at 3,890-4,142 ft. and the other at 4,150-4,235 ft.

The Duarte well and the new location both are in 17-2n-1w in Los Medanos field, Contra Costa County.

Trico Oil & Gas Co. recently drilled the 1 Valch unit to 5,474 ft. about ½ mile northeast of the Duarte well, but suspended operations after running electric logs. The Trico well has not been completed, nor has the company released any details on the test.

Test staked in California's West Grimes

An important stepout location has been made in California's West Grimes field, the Colusa County gas field that is rated as one of the best discoveries made recently in the Sacramento Valley.

Occidental Petroleum Corp. will drill the 1 O. P. Davis in 29-15n-1w. This is 1¾ miles northwest of the six-well field. Two wells currently are drilling in West Grimes. Several others are planned by the field's three operators, Occidental, Gulf Oil Corp., and Patrick A. Doheny, Los Angeles independent.

Discovery wells

OKLAHOMA

Caddo County:
Mobil Oil Co. 1 M. V. Weather, NE SW 8-12n-11w, 1 mile south of Bridgeport.

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IPCOF 1,292 M.c.f.d. with 3 BCPD, Cherokee 11,278-11,476 ft., SIP 4,725 psi., 55°. TD 12,337 ft. New gas-condensate discovery.

Cleveland County:

Union Texas Natural Gas Co. 1 Navy, 1½ miles south of Norman in NE SW SW 5-8n-2w. IPF 261 BOPD, Bromide, McLish, Oil Creek sands at 8,022-27, 8,444-54, 8,759½-60½ ft. TD 8,961 ft. PBTD 8,850 ft. Flow from McLish 350 BOPD, BOPD from Oil Creek. Triple-zone oil discovery.

Garfield County:

Apache Corp. 1 Hasselwander, SE SE NW 26-23n-3w, 1½ miles northwest of Northwest Antelope pool. IPP 50 BOPD, Miss. chat 4,830 and 4,840 ft. TD 4,886 ft. New oil discovery.

Grady County:

Gulf Oil Corp.-Tidewater Oil Co. 1 E. L. Wood, W½ SE NW 29-6n-8w, 1¼ miles southeast of Laverty. IPF 5 M.M.c.f.d., plus 34 BC per million per 8 hours, 13/64-in. choke, FTP 3,700 psi., SITP 8,552 ft., 47°, Cunningham 16,180-16,376 ft. Second deepest producer in Oklahoma. TD 17,000 ft. PBTD 16,461 ft. New gas-condensate discovery.

Haskell County:

LeFlore County Gas Co. 1 N. C. Holt, SW SW NE 33-9n-23e, 3½ miles northeast of West Milton gas pool. IPF 628 M.c.f.d., SIP 982 psi., basal Atoka sand 5,451½-54 ft. TD 5,903 ft. New gas discovery, shut in.

NORTH TEXAS

Jack County:

Regular field. Taubert & Steed et al. 1 Teague, 1½ miles northwest of Hermyn in Sec. 2772, TE&L Sur., A-714. IPF 71 BOPD, 42°, GOR 280:1, TP 100 psi., CP 400 psi. TD 2,564 ft. New oil discovery. Buthram sand open hole at 2,550 ft.

Montague County:

Clyde J. Brannan, Jr. 1 Bert Dimock, 1.3 miles southeast of Marenamag Congl. field. I. Garner Sur., A-287. IPF 240 BOPD, 12/64-in. choke, 44°, GOR 1,450, TP 140 psi., packer. Viola lime 6,686-6,710 ft. TD 7,055 ft. New oil discovery.

Bennett Oil Co. 1 Morgan Jones Est., 1½ miles northeast of Eanes Caddo field in Milby Berry Sur., A-23. IPF 225 BOPD, 20/64-in. choke, 41°, GOR 530:1, TP 180 psi., CP 690 psi. Caddo Conglomerate 5,761-71 ft. TD 6,965 ft. New oil discovery.

Stonewall County:

Sojourner Drilling Corp. 1 Minor Alexander, 18 miles northeast of Aspermont in Sec. 4, Blk. F, H&TC Sur. IPF 97 BOPD, open hole, 18/64-in. choke, 38°, GOR 100:1, TP 55 psi., packer. Bend Conglomerate open hole at 5,788 ft. TD 5,810 ft. New oil discovery.

Wise County:

Morris 5,900-ft. Atoka Conglomerate field. Luke Grace Drilling Co. 3 Hanna "B," 4 miles northwest of Bridgeport in J. G. Marsh Sur., A-1258. IPF 274 BOPD, 14/64-in. choke, 45.3°, GOR 1,820:1, TP 1,100 psi., CP 850 psi., 5,800 ft. Atoka Cong., open hole. TD 5,923 ft. New oil discovery.

TEXAS GULF COAST

Brazoria County:

East Bailey's Prairie field. Cyprus Oil Co. 1 M. S. Munson, 6 miles west of Angleton in HT&B Sur., A-297. IPAOF 4,750 M.c.f.d., SITP 3,232 psi., BHSIP 4,116 psi., GLR 167,500:1, 44.2°, Frio 10,736-50 ft. TD 12,240 ft. New gas-condensate discovery.

Hardin County:

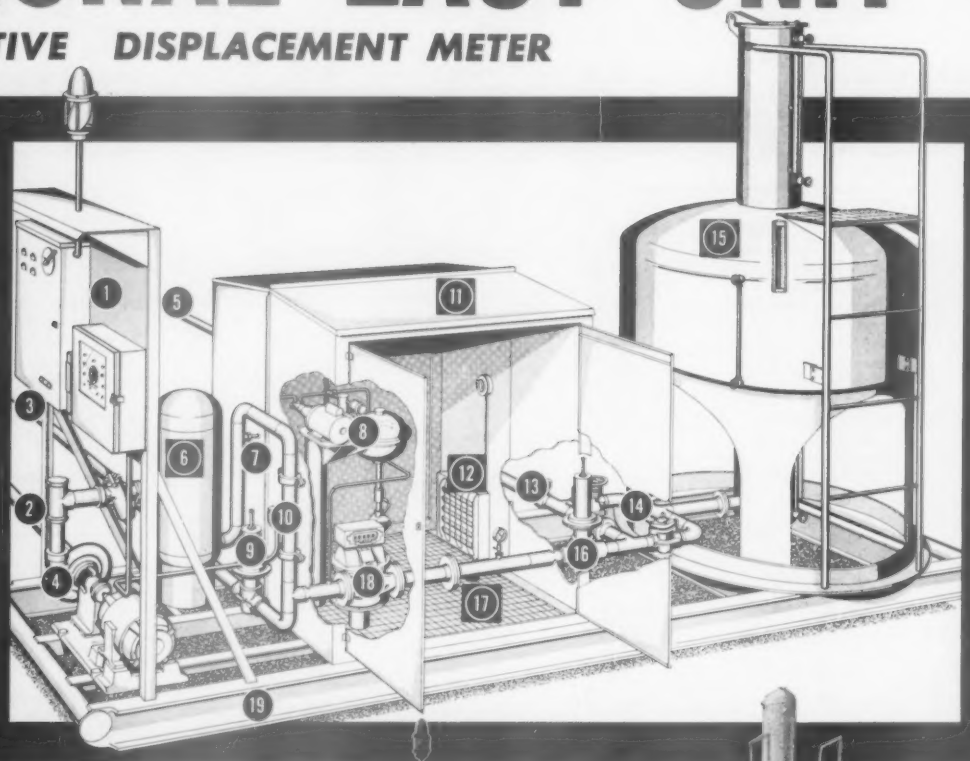
Dry Creek. Sinclair Oil & Gas Co. et al. 6 J. A. Vickers Fee, 3 miles northwest of Silsbee in J. A. Vickers Sur., A-52. IPF 2,560 M.c.f.d., SITP 2,218 psi. BHSIP 2,859 psi., GLR 21,200:1, 61.4°, 7-A Yegua 7,342-48 ft.; IPF 144 BOPD, 8/64-in. choke, TP 1,050 psi., GOR 703:1, 42.1°, 4-B Yegua 6,941-48 ft.; IPF 153 BOPD, 10/64-in. choke TP 850 psi., GOR 1,025:1, 40.6°, 2-A Yegua 6,681-86 ft. TD 11,075 ft. Triple discovery, dual oil and one gas-condensate pay.

Jefferson County:

High Island, offshore. Standard Oil Co. 1 Federal 52, 39 miles from Galveston in Blk. 52, Gulf of Mexico. IPF 295 BOPD, 12/64-in. choke, TP 1,930 psi., GOR 1,000:1, 37.4°. Miocene 8,520-56 ft. TD 9,922 ft. PBTD 8,532 ft. New oil discovery.

NATIONAL® LACT UNIT

WITH POSITIVE DISPLACEMENT METER



1. Skid mounted control rack with control panel, B S & W Monitor, power transformer and rotating beacon
2. LACT inlet
3. Rejected oil outlet
4. Transfer pump and motor
5. Pipeline delivery
6. Air eliminator
7. Sample probe
8. Sampler with container
9. Combination bad oil back pressure valve
10. Monitor probe
11. Galvanized meter house
12. Electric thermostat and explosion-proof heater
13. Pipeline check valve
14. Meter prover loop with double sealing gate valve in main line
15. API meter prover
16. Combination good oil and back pressure valve
17. Skid-proof flooring
18. PD meter with automatic temperature compensation and counter-printer
19. 6" I beam skids

● Indicates optional equipment. Other components furnished in basic LACT unit.

The National LACT Unit with Positive Displacement Meter is designed to meet the requirements of both producers and pipelines. Only four connections required to place this unit in operation:

1. LACT Inlet Line
2. Pipeline Delivery Line
3. Rejected Oil Line
4. Electric Power Input

UNIT OPERATION:

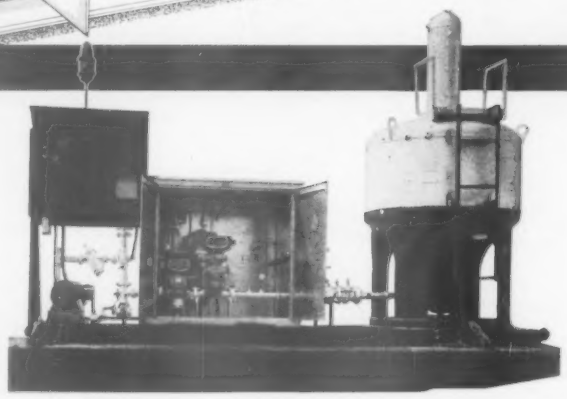
1. Oil from storage is pumped past a B S & W Monitor Probe. If fluid does not meet pipeline specifications, it is re-routed to the Treater or Wet Oil Storage.
2. Pipeline quality oil is metered by the Positive Displacement Meter with automatic temperature compensation. Proportionate samples are taken during delivery.
3. Back pressure and shut off valve insures accurate meter operation and positive control.

National PD/LACT units have been in constant service for over four years. They are now in operation in every major oil producing state and serving most major producers and pipelines.

Since LACT involves both the Producer *and* the Pipeline, it is much more than just a piece of production equipment. LACT is the final important link between the wellhead and the pipeline — a component in a complex system that can control the operation of the entire lease.

Varied lease producing characteristics may be accommodated from one standard arrangement by combining in-stock accessories to meet requirements while maintaining uniformity in design.

All acceptable brands of meters are available from National with stock delivery on some and trained service available on all.



The National PD/LACT is National Designed, National Engineered, National Fabricated, Skid Mounted and Operation Tested.

A PLUS VALUE WITH ALL NATIONAL PRODUCTS . . . Engineers and field crews living in your area with 55 stocked warehouses, complete units or parts ready to size, install and service National PD/LACT Units.

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DRAWER 1710

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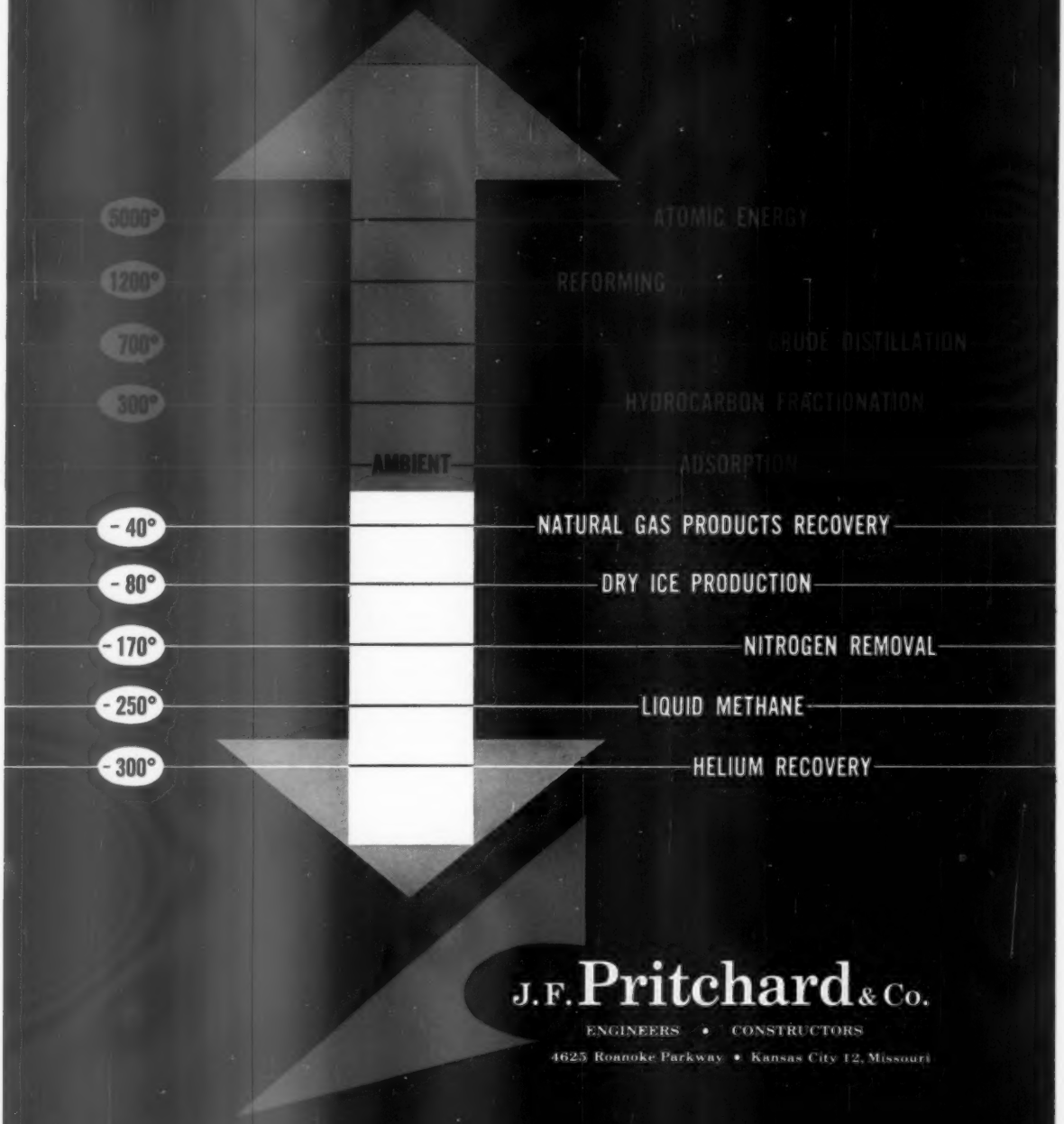

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